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IN THIS ISSUE:

PROPOSED HUDSON RIVER PONTOON BRIDGE
STARVING IN THE MIDST OF PLENTY

# SCIENTIFIC AMERICAN

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*A Weekly Review of Progress in*

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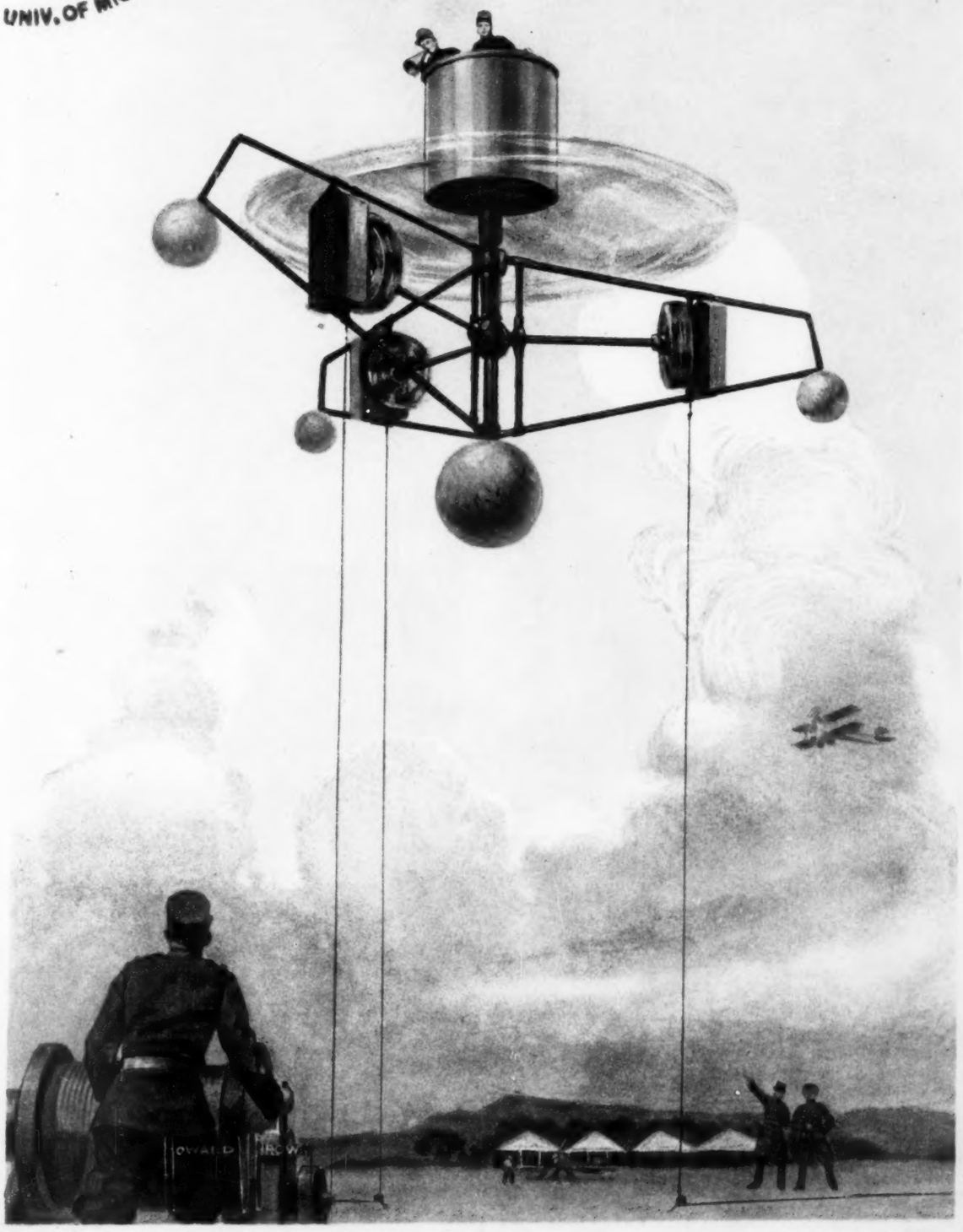
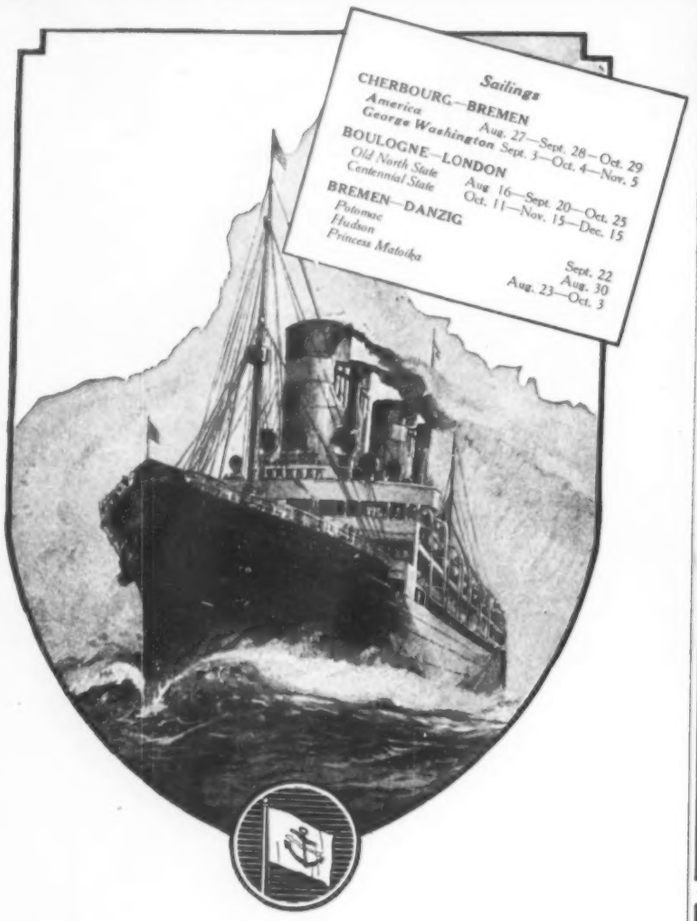


ASCENDING TO A HEIGHT OF 120 FEET IN THE PETROCZY CAPTIVE HELICOPTER.—[See page 117]

Vol. CXXV. No. 7
August 13, 1921

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 15 Cents
20 cents in Canada

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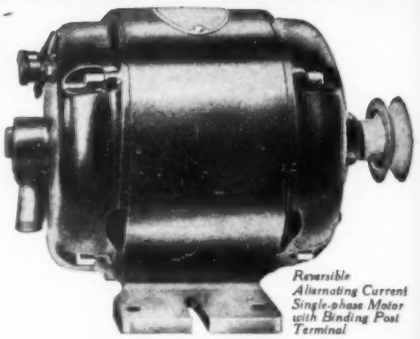

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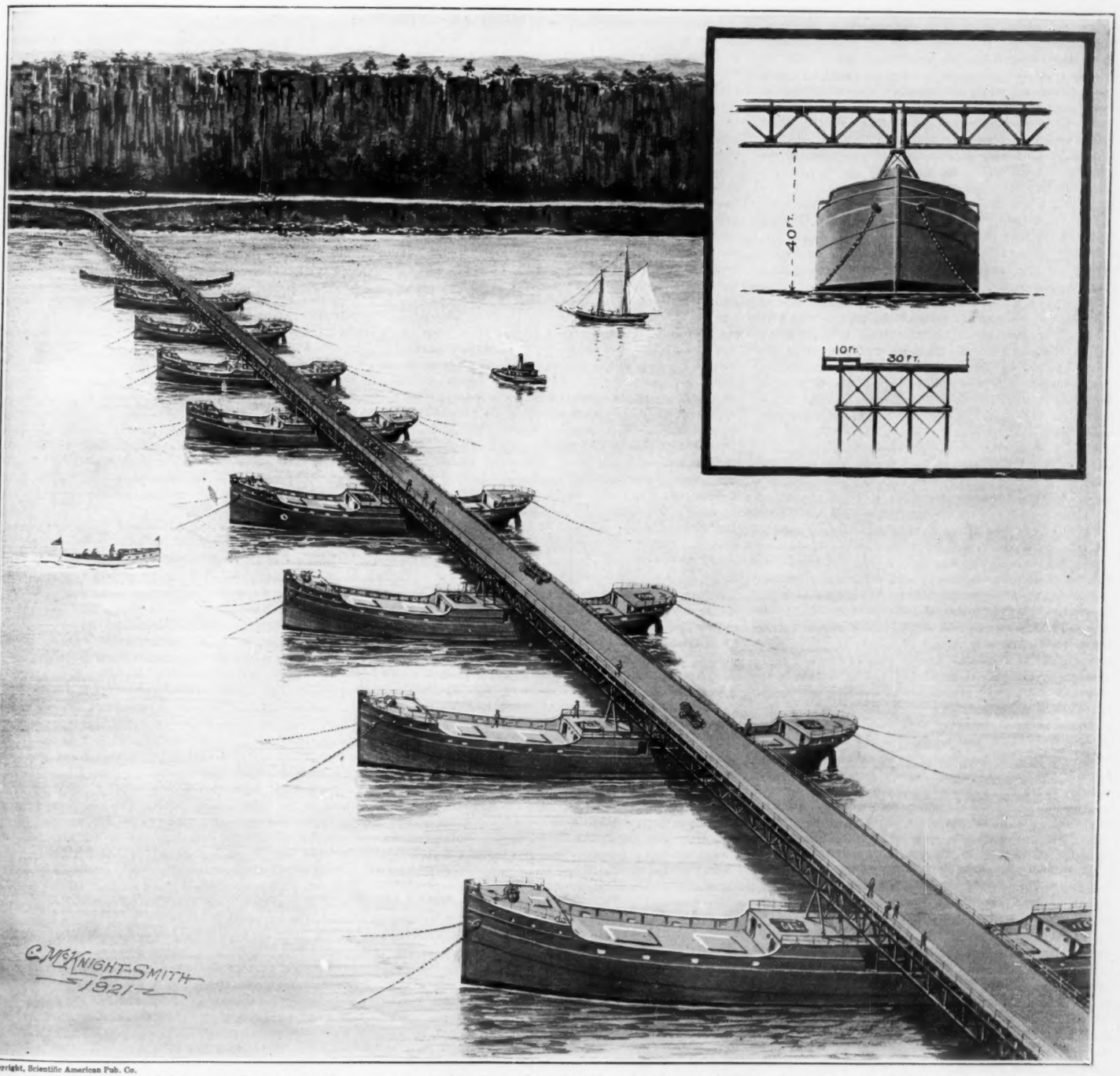
# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXV.] NUMBER 7 NEW YORK. AUGUST 13, 1921 [15 CENTS A COPY 20 CENTS IN CANADA

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**General view of the proposed pontoon bridge across the Hudson River for vehicular and pedestrian traffic, and a cross-sectional view of one of the ship units—[See page 117]**

THE SCIENTIFIC AMERICAN, August 13, 1921. Volume 125, Number 7. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

# SCIENTIFIC AMERICAN

**Published by Scientific American Publishing Co.**
**Founded 1845**
**New York, Saturday, August 13, 1921**
**Munn & Co., 233 Broadway, New York**

Charles Allen Munn, President; Orson D. Munn, Treasurer
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## The Hudson River Pontoon Bridge

THE proposal to build an emergency pontoon bridge across the Hudson River, as illustrated elsewhere in this issue, is entirely feasible. As a means of crossing straits and rivers, the pontoon bridge was not only one of the very earliest and most widely used types of bridge, but, for particular purposes and to meet special conditions, it has held its own for over 2000 years and is today in widely extended use. Every schoolboy is familiar with the feat of Xerxes, who built a double bridge across the Hellespont, one span being carried on 360 and the other on 314 vessels, anchored up and down stream. He will remember, also, how Darius, in his war against the Scythians, used the same device to get across the Bosporus and the Danube, as did the celebrated Ten Thousand when they crossed the Tigris in their retreat from Persia. For military operations, pontoon bridges have held their own down to the present time, and the pontoon section forms today a most important branch of the engineering force that accompanies every modern army.

The service which this type of bridge has rendered in military operations is matched by its usefulness in linking together the highway systems of the world. Former visitors to Constantinople will remember the famous bridge of boats between that city and Stamboul; and every tourist who has made the trip up or down the Rhine has passed through the floating swing bridges in the center of the great pontoon structures which span that river at such places as Cologne and Coblenz. Since the armistice, several military pontoon bridges have been thrown across the Rhine, in order to facilitate the movements of the various Armies of Occupation between the right and left banks of the river.

There are two questions to be answered in considering this startling proposition to bridge the Hudson at a point where it is over a mile in width, and these are: first, is there any emergency call for such a bridge? and secondly, is it practicable? Answer to the first question is to be found in the present intolerably crowded conditions of automobile traffic at the ferries which afford the only means of vehicular communication across the Hudson. At any time of the day there is an irritating wait to get across, and at certain hours there is a wait which means a very considerable loss of time out of a business day. It is on Saturdays, Sundays and holidays, however, that the congestion reaches proportions which are unbelievable except by those who have had the misfortune to be caught in it. Frequently the line of waiting cars will be backed up for several miles along the roads leading to the ferries; and on a recent holiday, after waiting many hours on the western side of the river, New York and Long Island owners, in despair, actually abandoned their cars for the time being.

As to the feasibility of the bridge there can be no question whatever. The Ferris wooden ships, obtained from the Shipping Board, are vessels of over 3000 tons; and when they are moored to heavy anchorages up and down the stream, and the mooring cables drawn taut, they will afford a foundation for the trusses, so secure, both vertically and laterally, that the bridge will have a stability which will compare favorably with a permanent structure. A ship of over 3000 tons will be practically unaffected by such small waves as disturb the surface of the Hudson River. The steelwork for the towers and trusses can be built within 90 days; and since the boats are immediately available, it is estimated by Mr. Lindenthal that, if there are no legal delays, the bridge can be opened to the public by the end of May, 1922. It should be noted that were it not for the fact that the boats are immediately available at a nominal cost, it would not be possible to entertain the idea of building a bridge of this magnitude; for the proposed structure will be by far the largest of its kind ever constructed. But with the boats available and because of the standard shapes of which the towers and the trusses will be built, both the time and cost of the erection of the bridge will be reduced to a minimum.

## Inventing a Crime

CIVILIZATION in the beginning was a simple thing. There was no elaborate machinery of government, of industry, of daily life. And with everything else, right and wrong were of the simplest. A member of this primitive society could take his neighbor's life by force; he could take his neighbor's property by force; beyond that there was little that he could do to wrong him. There were accordingly few laws, and these simple ones, applying merely to what we recognize as natural crimes. It was not even necessary to define the crime; the law was merely for the purpose of defining the penalty. Thou shalt not kill; thou shalt not steal; thou shalt not covet thy neighbor's wife—that would cover the ground; thou shalt not bear false witness was a later development. And it was always easy to determine whether a particular offense had been committed.

With the growing complexity of civilization it became possible to wrong a man in more ways, and in more devious ways. It became possible, without actually using force or doing anything recognizable as an outright, natural crime, to come out of a transaction in possession of another's property and without having given any fair return therefor. As trade and commerce and government developed in complexity, bribery and conspiracy came into existence, and opened the way to an immense variety of operations whereby one might defraud a man of what was rightfully his. At a comparatively early stage in the world's history it became feasible to proceed against a man's property or person in such a way that proof of the wrong done should be more and more difficult to present, while even definition of the crime committed might turn out to be considerable of a puzzle.

The net result of all this is a sort of race between the offender and the law. We have continually the invention of new ways of getting the best of the other fellow—we might say, with our heading, the invention of new crimes, but that they are not crimes until the law-making power has had its innings and made them so. Conspiracy in restraint of trade, extortion of a rental out of all proportion to the value of the premises—these are among the less disreputable examples. Sharp practice though they be, they are defended eloquently by many more or less sincere gentlemen; but in the public interest they are defined as crimes and the penalty fixed. It then is the move of the sharpster again, and he develops a new procedure for getting his fingers into his neighbor's pocket-book. So the game goes on, endlessly.

As a rule it seems that the crook and the sharpster are a little ahead of the law. This is entirely natural. The law must necessarily follow the transgressor rather than lead him. The law-makers cannot meet together and allow their imaginations to run wild in picturing all the devices that might be conceived by a clever crook for the purpose of relieving the individual or the community of superfluous cash; they can at most only provide for the known and established ways of doing wrong. The field must necessarily be left open for the ingenious transgressor to devise ways of achieving his ends that have not as yet been specifically prohibited. The way must necessarily be left free for him to teach us these artifices by putting them into execution—only after we have had such tuition can we expect our law-makers to move the barrier so that it shall include the latest procedure among the things forbidden.

A case in point is furnished by the Chicago baseball scandal. We have no doubt that on numerous occasions disgruntled ball players have failed to exert their efforts to win, or have actually done what they could to betray their club. But concerted throwing of ball games for money, if we are to credit the testimony offered in this case, has been put on a business basis never before attained. A new crime has been invented; and the legislatures of numerous states have responded by defining the offense and the punishment. But it appears that, if the inventor of a crime cannot get a patent to reward his ingenuity, he at least has the consolation that his practice of this crime will go unpunished, where a subsequent imitator lays himself open to the law that has been enacted as a result of his predecessor's activity.

## The World's Merchant Marine

IN the midst of the uncertainty which beclouds the immediate future of shipping, there is a certain measure of satisfaction in having the exact figures before one, showing just how much shipping there is in the world today, and what is its distribution. These facts are to be found in the new edition of *Lloyd's Register*, in which the usual details are given of the seagoing vessels of all the maritime nations, including ships from 100 tons up to the 56,000-ton transatlantic liners.

The world's total of shipping today is made up of 33,296 vessels of 61,974,653 gross tons. Before proceeding to consider the larger totals, it should be noted that the gradual reduction in sailing tonnage continues; although the increase in this type of vessel which has occurred in this country has tended to slow down somewhat the general *decrease*. It is a curious fact, which will be news to many of us, that over 40 per cent of the sailing ships of the world are owned in this country. The decline is shown in the following figures: In 1902 about 22 per cent of the world's tonnage consisted of sailing ships; in 1914 the percentage had decreased to 8 per cent; and in 1921 to 5 per cent. The increase in wooden vessels from 1 per cent of the total steam tonnage in 1914 to nearly 4 per cent in 1921 is to be attributed, of course, mainly to our own construction of wooden steam vessels to meet the emergencies of the war.

In spite of the large amount of German tonnage which was allocated to British owners and the huge program of new construction which has been under way since the armistice, the total tonnage of the United Kingdom in 1921 is only 411,000 tons more than it was in 1914. Here is an impressive evidence of the terrific inroads made on British shipping by the wear and tear of the war and by German submarine attacks. On the other hand, the seagoing tonnage of this country has seen during the same period an increase of about 10,400,000 tons, an advance of not far from 600 per cent on the total for 1914. This, of course, gives us a strong position in the second place among the great maritime nations.

Conversely, although Germany in 1914 stood next to the United Kingdom with a total of over 5 million tons of seagoing shipping, her merchant marine today includes only 654,000 tons of shipping.

In the matter of relative standing, as shown by a comparison of 1914 and 1921, the percentage of the world's seagoing steam tonnage owned by the United Kingdom has fallen from 44½ per cent to about 35½ per cent. The United States' percentage has risen from 4.3 per cent to 22.7 per cent. Japan now stands in the third position, with France a close fourth. Norway, formerly in the third place, has now, largely by reason of the depredations of the submarine fallen back to the sixth position.

A strongly accentuated development in shipping is seen in the growth both in numbers and tonnage, and in individual size, of steamers for the carriage of oil in bulk. In 1914 the total number of steamers engaged in this service was 385, whose total tonnage was 1,479,000. Today, according to *Lloyd's Register*, there are 861 oil carriers driven by steam or motor, with a total of 4,419,000 tons. That is an increase of 200 per cent in seven years. Of these vessels 55 are from 8000 to 10,000 tons, and 37 are over 10,000 tons in measurement.

Another notable development has been the use of oil for propulsion either under the boilers or in heavy-oil engines. Oil-burning steamers have increased from 364, of 1,310,000 tons in 1914, to 2536, of 12,797,000 tons. Unquestionably, if the supplies remain fairly constant, oil is destined to displace coal in the merchant marine, except for special ships, or in lines of service where the routing and supply conditions are favorable to coal.

## Naval and Merchant Marine

**A 4000-Pound Demolition Bomb.** — According to Army Ordnance, the progress in the size of bombs continues at a rapid rate. Illustrations are given of the new 2000-pound bomb, of the kind which sank the "Ostfriesland" in the tests described in these columns last week, and of a 4000-pound bomb. The 2000-pound bomb is a little over 13½ feet long, about 19 inches in diameter, and carries 1000 pounds of explosive. The 4000-pound bomb, 13½ feet long, and about 23 inches in diameter, carries one ton of explosive.

**German Ships Will Be Up-To-Date.**—German surrendered tonnage will not be a loss to the ship owners, since the Government will give them about 12 million marks for the rebuilding of their fleets, and the new ships will be built in German yards. According to the *Shipping World*, the Treaty has overstocked the harbors of the Allies with shipping, much of which is old in design. Consequently, a few years from now, when the Germans have made good progress in reconstruction and possess ships of the most modern type, the surrendered vessels will be obsolescent; and the disadvantage under which it was expected that German prewar shipping would labor will perhaps be converted into actual advantage.

**Engineers Investigate Panama Canal.** — A new board has been appointed to investigate the operation of the Panama Canal and determine how to make the Canal Zone more efficient and less expensive as a Government concern. It is in line with modern thought that the Secretary of War should have recognized that the engineering profession is particularly well qualified for this work. He has appointed to the Commission three engineers, and a representative from the allied public utility field. It stands to reason that these men will make a more understanding survey than would be possible in the case of the politician to whom such a task is frequently assigned.

**Sixteen-Inch Coast-Defense Gun.**—In the shop tests of the new 16-inch barbette carriage for coast defense, recently completed at the Watertown Arsenal, the carriage functioned very satisfactorily. The load required on the slow-motion hand-wheel to traverse the piece was 17 pounds. It took 27 minutes, using man power, to elevate the gun from 0 degrees to 60 degrees. The electric traversing and elevating equipment had not as yet been assembled. One of the most difficult problems in designing the carriage was the control of the gun, which, with its recoil band, weighs about 200 tons. The gun will have an all-round fire and will throw a 2340-pound armor-piercing projectile to an extreme range of 55,000 yards. It can penetrate 14 inches of armor or more at all ranges up to its maximum.

**Shipping Board Finances.** — According to the new Chairman of the United States Shipping Board, there are outstanding claims against the Board of about $320,000,000, and there is a working deficit each month of about $21,000,000. This means that until conditions improve and unless they improve, the country must pay out an annual subsidy of nearly 250 millions of dollars to keep things going. As matters stand, the nation is called upon to make a choice between three conditions: either the ships must be sold for what they will bring in the open market, or we must make such revision of our shipping laws and such reorganization of the Shipping Board as will make them more efficient, or we must be content to subsidize our merchant marine to an extent which will maintain it as a going concern in the face of the fierce competition that exists among the world's sea-going carriers.

**New Dock for the Port of London.**—There was recently opened on the Thames, 6½ miles below London, in the general neighborhood of the Royal Albert Dock, a new dock which will accommodate vessels of up to 30,000 tons. The entrance lock is 800 feet by 100 feet, with 41 feet 8 inches over the sill at ordinary tides. The water area of the enclosed basin in which the lock opens is 64 acres, and the depth 38 feet. There are 10,000 feet of quay wall, capable of berthing 14 steamers of the largest size. The length of the dock is 4578 feet, and the width varies from 500 to 710 feet. Two lines of railway are laid along the quay; next to these are 3300 feet of two-deck sheds, and at the rear of the sheds are three lines of railway—an arrangement which should greatly facilitate the complex business of interchange between ship, car and truck. The piers and sheds are served by 24 electric level-luffing cranes, and each shed is further equipped with eight electric cranes of one ton capacity each. As a final touch there is immediately adjoining the basin a new dry-dock 750 feet long, 100 feet wide and 35 feet deep on the blocks.

## Science

**Glass and Tin Churns.**—A patent was granted in England in 1851 for a cylindrical glass churn, and these were tested at the Exhibition of 1851 in competition with French tin churns, and the old English wooden churns. The small wooden family churn worked so well that it was awarded a prize medal over its more aristocratic glass relations.

**A Large Gift to Science.**—Baron Edmond de Rothschild, member of the French Institute, has announced to the Academie des Sciences his intention to devote the sum of 10,000,000 francs to the foundation of a laboratory of scientific research. The announcement is accompanied by the request that the Academie will nominate two of its members to the administrative council of the proposed institute, which will be chiefly devoted to the development of physical and chemical science and its application to industry and agriculture.

**The U. S. Pharmacopaeia for China.** — The U. S. pharmacopœia is being translated into the Chinese language under the direction of the Philadelphia College of Pharmacy and Science. Before the war Germany tried to have the German pharmacopœia translated into Chinese with the object, of course, that German manufacturers might export to China drugs of German standards. Great Britain has made similar attempts since the war, but our own standards are to be adopted.

**Machine for Raised Embroidery.**—The United States Consul at Lyons reports the invention of a machine at that place for the making of raised embroidery in gold and silver. It is stated that the stitch is a copy of an ancient form of embroidery and gives an impression of handwork, and is also the first machine that has been successful in using the metallic thread. Various machines have been employed in the making of raised embroidery in other threads. It is stated that the machine is the result of seven years of study, and that the results are very satisfactory.

**Three Thousand Dollars An Inch for a Shower.** — An official of a Wisconsin organization telegraphed to a Canadian rain maker offering $3000 an inch for a precipitation. This organization represents 3500 Wisconsin farmers. This same Canadian rain maker on one occasion made $8000 for 4.24 inches fall. It is said that his rain-making equipment consists of a tank 20 feet high in which a chemical mixture is prepared which he says "opens up the clouds." Of course little stock in such plans or devices is taken by the scientific meteorologists.

**The High Swiss Fares Vex Tourists.** — The Swiss railways are most admirable and the conditions are ideal for the tourists but unfortunately for them fares have been raised to such a point that very few of the tourists travel first class and many of them do not travel at all on the railroads, electing to go by automobile over the magnificent roads with which Switzerland is traversed. Where parties travel together the automobile effects a real economy and it is even cheaper for persons traveling between Italy and Switzerland to cross one of the passes by automobile than to use either the Gotthard or Simplon tunnels.

**Tear Gas for Riots.**—A test has recently been made in Philadelphia of tear gas as a means of quelling and dispelling a mob. The test was entirely successful and six policemen from Philadelphia were able to rout 200 of their stalwart companions. The movies have already demonstrated how banks and safe deposit vaults can be protected by gases placed in tubes behind the vault doors. An excellent point about the gas is that it leaves a reddish brown stain upon the clothing which would aid in identifying those taking part in riots or crime. Those who inhale the fumes become helpless for a time but the effects soon wear off. The underworld has already put in an order for masks to foil the police tear gas.

**Misleading Accident Statistics.** — One of the most prominent New York papers, always noted for its accuracy, recently stated that there were 11,000,000 persons killed and maimed by accidents for a year. This would certainly be a very serious situation if true, but as a matter of fact, in the entire registration area in Continental United States there were only 1,096,436 deaths from all causes, and in the same registration area in 1919 there were 61,266 deaths from accidental deaths. Dr. Crum, an expert statistician, gives the figures of accidental deaths in Continental United States in 1919 as 75,546, using the usual method of computing population. The statement first quoted is on a par with many other statements relating to safety. The National Safety Council and the Safety Institute of America are in a position to give authoritative figures when necessary.

## Aeronautics

**A New Use for Airplanes.**—It is reported that airplanes are doing useful and most unusual work in France in dealing with the plague of grasshoppers on the Crau Plateau (north-west of Marseilles) which is far more serious than it was last year, crops of all kinds being destroyed over some 100,000 acres. Pilots report breeding grounds and scatter poisoned bran.

**A Worth-While Flight.**—For some reason a really fine flight has been allowed to go by with little or no mention in the daily press. It appears that an Ansaldo plane of Italian manufacture recently flew from Mineola, Long Island, to Chicago, in 7½ hours, flying time. It was piloted by Lloyd Bertaud and carried three passengers and 500 pounds of express matter for the American Railway Express Company.

**French Prize for Helicopters.** — The French Aero Club has decided to offer a prize of 25,000 francs for the first helicopter that shall prove its power to rise direct from the ground in a theoretical cylinder to a height of 25 meters and return direct to the spot from which it started. The rules of the tests are to be drawn up by the Aviation Commission of the Aero Club.

**Rivers as Airways.**—Just so long as we lack suitable airways and airdromes, it appears that the safest practice is to follow our leading waterways, such as rivers, canals, lakes, coast lines, and so on, using seaplanes for the purpose. In this manner a pilot can always make a relatively safe landing, as compared with the airplane pilot flying over rough country devoid of landing fields. A number of rivers and other waterways have been surveyed with this object in mind.

**Information for Aviators.** — On November 1st last the Hydrographic Office began the publication of *Notice to Aviators* which will be issued monthly if sufficient interest is shown and sufficient information is available. Information from aviators and parties interested is expected to return for this service. The publication contains such items as data on landing fields, weather reports, specifications for landing fields and so on. Persons desiring *Notice to Aviators* should address Hydrographic Office, Navy Department, Washington, D. C.

**How Safe Is Commercial Flying?** — The manufacturers Aircraft Association have recently completely an aviation survey of the United States, which sheds interesting light on the safety of commercial aviation. It is said that in the past six months the 1,200 commercial planes in operation in this country had flown approximately 3,230,000 miles. In these three and a quarter million miles of travel, only 15 persons were killed and 43 injured, in a total of 27 serious accidents. Most of these accidents occurred among that class of civilian aviators known as gypsy fliers.

**The Oehmichen Helicopter,** so we learn from our European contemporaries, has made a number of successful flights. This machine, it will be recalled from the description and photographs recently appearing in these columns, consists of a gas bag and a suspended framework which carries two huge horizontal air screws. The gas bag, we now understand, is employed only during the present tests and eventually will be eliminated when pilots become sufficiently familiar with helicopter flight. In the seventy-sixth flight this helicopter flew 75 yards against the wind.

**McCook Field's Big Engine.**—The Engineering Division at McCook Field has completed the preliminary design of a 1,000-horsepower 18-cylinder engine, so we learn from *Aviation*. The design has been developed on the basis of 1,000 horsepower at 1400 r.p.m. direct drive, this speed insuring great reliability and being favorable to high propeller efficiency in connection with a large power output. The cylinders are designed to accommodate four spark plugs per cylinder, which has some advantage from the point of view of power output and economy. Furthermore, it is planned to use four independent magnetos, thus securing the utmost reliability through the use of four independent ignition systems.

**Flight of Man-Driven Plane.** — At last something definite has been done with "aviettes"—those fantastic combinations of bicycle, wings, and even air screws, which are supposed to fly but generally don't. We learn from newspaper reports that Gabriel Poulain, the French champion cyclist, succeeded on July 9th last in the Bois de Boulogne in winning the Peugeot prize of 10,000 francs for a flight of more than ten meters distance and one meter high in a man-driven airplane. Four times he flew over the required distance, his longest flight being over 12 meters. His machine is a bicycle equipped with planes the angle of which can be varied. The present success of this aviette is said to have been due to changing the angle of incidence in the rear wing.

# Railroading Under Roof

## Where the Severity of the Weather Practically Makes Transportation an Indoor Game

By Charles Frederick Carter

A graphic demonstration of why they have snowsheds at Blue Cañon, Cal.

OPERATION of the Southern Pacific Railroad over the Sierras on the Ogden Route between Sparks, Nev., 537 miles west of Ogden, and Roseville, Cal., 139 miles farther west, presents difficulties, to overcome which, expedients in construction, maintenance, equipment and operation have been evolved that together constitute a bit of railroading spectacular enough to impress even the unsophisticated. Briefly summarized, these difficulties include the operation of a single track railroad having grades ranging from 79.2 to 125.14 feet to the mile and curves up to 10 degrees radius, on which train movements average one in each 21 minutes of the 24 hours exclusive of the movements of helper engines, and in a region where the annual snowfall sometimes amounts to more than 65 feet and averages two-thirds of that amount. In order to cope with this extraordinary precipitation the company is obliged to maintain 30 miles of snowsheds in a distance of 41 miles, 29 miles of the sheds being concentrated in 30 miles of line. While snowsheds are not rare on mountain roads nothing approaching so great a mileage of railroad under roof is to be found anywhere else in the world.

The snow is concentrated in a period of three months. It is very wet and heavy; and as there is little wind it lies where it falls. Very little goes off during the winter. It keeps settling until the average depth on the level is 15 feet, though a depth of 26 feet has been measured many times. This makes the snow very heavy with streaks of ice in it. Slides are frequent and disastrous.

These conditions call for two types of sheds: one to keep the snow off the track, and the other both to keep the snowfall off the tracks and also to convey slides safely over. Both must be very heavily constructed, for they are designed to sustain a load of 300 pounds to the square foot. These sheds contain 100,000,000 feet of timber, which lasts an average of 26 to 30 years so that renewals are constantly going on at the rate of about a mile a year.

Telescopic section of double-track snowshed at a siding

So great a mass of dry timber constitutes an unusual fire hazard. Instances are recorded of fires being started by the explosion of a carboy of acid, carelessly loaded in a way car contrary to the rules, and by a sliver from a red hot brake shoe. Members of the I. W. W. and other vagrants have also started fires, but the principal danger is from brush fires started by careless automobile tourists.

To guard against this danger a unique fire department has been developed. A few miles back from the line west of the summit stands Red Mountain, an isolated peak, 7800 feet high. On the top of this peak an observatory has been established in which two men are constantly on duty. As the summit is more than 800 feet higher than the highest part of the line the observers can see all of the 29 miles except two short sections hidden by spurs. An engineer's transit to which is attached a pointer traveling over a chart is mounted in the observatory. By training the transit on a suspicious smoke the pointer indicates on the chart the exact location. The observers do not wait to see whether a fire is in the sheds or in the brush, but telephone immediately to the fire stations. In addition carefully trained men patrol inside the sheds day and night, reporting from boxes stationed something less than a mile apart.

Four fire trains, consisting of a locomotive with a fire pump mounted on the boiler, two water cars each with 12,000 gallons of water and a crew of four men, are stationed in a distance of 41 miles. In tests they have moved within 1½ minutes after receiving an alarm and they can go 40 miles an hour. Any point in the sheds can be reached by two fire trains within 15 minutes. To prevent fires getting beyond control and destroying the entire shed system telescopic sections are spaced about 5000 feet apart, though it is planned ultimately to space them 1000 feet apart. These telescopic sections are 96 feet long and mounted on car wheels rolling on rails at the sides of the shed. A locomotive is hitched to them and they are hauled into the adjacent shed for the summer when the fire hazard is greatest.

Chief interest in this roofed-in railroad lies in its operation; for in the sheds ordinary methods cannot be applied.

Even the locomotives are of a remarkable type to be seen nowhere else. Officially they are designated as "Mallet Moguls," and "Mallet Consolidations," the name being derived from the wheel arrangement, which is that of a Mogul or a Consolidation doubled up. But to the railroad men they are known as "Wompuses." The Mogul Wompuses which are assigned to passenger service have cylinders 25 and 38 by 28 inches, drivers 63 inches in diameter, weigh 396,000 pounds and develop 74,200 pounds' tractive power. Consolidation Wompuses, designed for freight service, have cylinders 26 and 40 by 30 inches, drivers 57 inches in diameter, weigh 435,000 pounds and develop 94,880 pounds tractive power. The chief peculiarity of the Wompus is that it runs backward, the cab being placed foremost in order that the low visibility in the snowsheds may not be further obscured by smoke. The tender, with a capacity of 10,000 gallons of water and 3600 gallons of fuel oil, is coupled to the smoke-box end. The stack has a deflector to turn the exhaust horizontally.

From Sparks, which is 4413 feet above the sea, to Truckee, 37 miles distant, there is a climb of 1406 feet. Here the real climb for west-bound trains begins. Soon after leaving Truckee the train enters the Coldstream development, a loop laid up one side of a narrow valley and back on the other side, a distance of 24,500 feet to gain a distance of 2000 feet. The western end of the loop enters the snowsheds. The average grade from Truckee to Summit, a distance of 15 miles, is 80 feet to the mile though the ascent is not uniform, the worst grade being 125.14 feet to the mile. At Summit the helpers are cut off, leaving the Wompus to hold the train down the hill alone.

From Summit to Roseville the distance is 87 miles by the track although in an air line it is only 64 miles. In this distance the train drops from an altitude of 7018 feet to 163 feet above sea level, or a total descent of 6855 feet, some of the grades being 120.38 feet to the mile. In this distance there is an aggregate of 11,219 degrees of curvature, some of the curves being 10 degrees "and over," according to the engineering department.

The train halts at Summit while brakes and air signals are tested. Then all retaining valves are turned up, and the engineer hav-

(Continued on page 123)

A panoramic summer view of the Southern Pacific snowsheds near Cisco, Cal.

## Saving St. Paul's in London

**By M. Macartney, F.S.A., Architect in Charge**

SIR CHRISTOPHER WREN, if the statement in "*Parentialia*" is to be credited, considered the soil that supported the central tower of old St. Paul's to be sufficient to carry his proposed dome. The central tower of old St. Paul's was 50 feet square, and approximately 260 feet high, carrying a lead-covered spire thereon some 250 feet high. Any calculations that one can make at this stage as to the weight of the old tower and spire must be very rough indeed, but the weight of a Gothic structure of the kind is, as a rule, comparatively light, and it is probable that the soil was not loaded so heavily as by the supports of Wren's dome. The present dome weighs approximately 60,000 tons, which is carried by 8 main piers, the area of the foundation of each of which is approximately 1400 square feet. This gives a pressure on the soil of approximately 5⅓ tons per square foot. The foundations are based upon the same layer of clay, or so-called "pot earth," as that upon which the old cathedral was founded. This clay should be able safely to withstand the load, though in planning a new building today, one would not probably put a pressure of more than 3 to 4 tons a foot thereon, in order to avoid undue compression and settlement. The area of the Cathedral is adequately drained, but there is water in the sand beneath the layer of pot earth about 13 feet below, which keeps the clay damp. Since the building was completed there are no special signs of settlement of the foundations, and certainly no movements have been noticed since close observation has been given to the matter in the last quarter of a century. The water level in the subsoil seems to remain fairly constant, and so long as it is not completely drained the clay will probably retain its present consistency. To underpin the foundations down to the London clay some 24 feet below would be a very difficult enterprise, and extremely costly, and would hardly be warranted.

Next to the quality of the foundations comes the construction of the piers. It seems strange that Sir Christopher Wren, after severely criticising the methods of the mediæval architects, should have adopted a similar system; that is, a facing of wrought stone filled with rubble in lime mortar. The natural result followed; that is, the core of rubble and lime contracted as it dried and was compressed by the increasing weight of the superstructure of the building, thus throwing an undue stress upon the casing. I may here interpolate the remark that for many years the book "*Parentialia*" has been regarded as an authoritative source of information about Wren and St. Paul's. It was published by Stephen Wren in 1750, and contains a picturesque account of his grandfather's works, founded on material by his father Christopher Wren, the younger son of the great Sir Christopher.

When one is able to test the accuracy of this work, however, it is generally found to be untrustworthy; so much so that unless a statement is corroborated by collateral evidence it cannot be accepted as true. Therefore, the assertion that the settlement of the southwest pier was due to the unequal temper of the soil may or may not be the fact, especially when we find from the accounts that a considerable amount of

(*Continued on page 123*)

**One of the gigantic cylindrical screens that keep the river debris out of the water used in Louisville's power station, raised and being cleaned**

## Clean Water for the Power Plant

**By George T. Holmes**

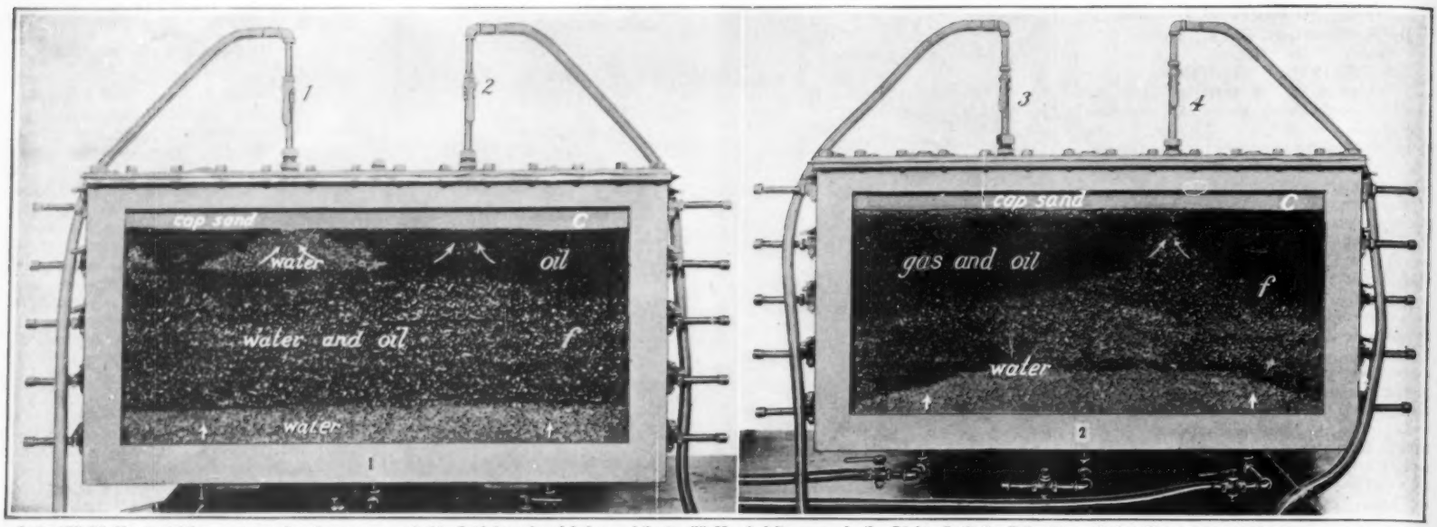
LEAVES and twigs that float in rivers and lakes have created a problem that has long puzzled engineers of gas and electric generating stations in our inland cities. This débris although apparently insignificant in size is able to clog up almost any sort of screen now in use in such plants for straining the river water used in the turbines and condensers. Until recently the only sort of screening device has been a vertical screen or set of screens; but with these it has become practically impossible to raise the screens for cleaning in the face of the pressure of the water against the lower section of the screens, which gets clogged into a solid wall of mud and leaves.

Engineers of the Louisville lighting company have discovered a better method than the vertical screen process and point out its beneficial results to other engineers confronting the same problem. The device is a duplicate set of three concentric cylindrical screens sixty feet high and about ten feet in diameter. Each set is capable of supplying sufficient water to run the plant, but the duplicate was installed a few months ago to have ready for use in case of any possible mishap. The screens are raised in a tower 120 feet high and cleaned one at a time. While one screen is in the air, the water is strained through the other two, so that at no time are there less than two screens in use.

Conditions at Louisville probably are typical of those prevailing at most of the towns which take condensing water from inland streams. The river rises and falls through about forty feet. The Ohio drains a water shed which becomes covered with leaves, weeds, etc., every fall. This rubbish does not come down regularly or gradually, but comes with the freshets, and unless screening equipment is ample and designed for ready cleaning it will become foul and fail to pass sufficient water. To make matters worse, the clogging of the screens causes them to act as dams, lowering the water on one side and keeping it up on the other, so that the pressure against the screens, the flat kind being in use, frequently makes it impossible to move them, necessitating often a complete closing down.

The equipment now in use in Louisville consists essentially of three cylinders of wire netting, set concentric in a deep well. The water comes up through the floor which carries the screens, into the center of the smallest screen. It flows outward through all three screens, which can be raised and lowered separately for cleaning purposes.

**Repairing old St. Paul's Church in London. *Left:* Making the preliminary examination of the structure. *Right:* Pouring liquid cement into a crack**




*Left:* "Well" No. 1 yielding water under the pressure of this fluid introduced below, while "well" No. 2 delivers good oil. *Right:* Both "wells" giving oil, but No. 4 on a much more generous scale because of the gas being pumped into the sands beneath it

**Two laboratory experiments on miniature oil sands, which go to show why one of two nearby wells may produce while the other yields nothing but water**

# Getting the Rest of the Oil

## Laboratory Tests That Reveal the Underground Secrets of the Petroleum Field

By Robert G. Skerrett

THE problem of a sufficiency of petroleum for the near future has more than once of late perturbed both Government and private technicists, and with reason. Most of us are aware that liquid fuel is rapidly supplanting coal in many directions, and because of the greater efficiency of crude oil and its derivatives as a source of energy we, as well as the rest of the progressive nations, are profoundly modifying our engineering practices. Accordingly, it is growing more essential to our industrial and commercial well-being that we continue to have an ample supply of petroleum at our disposal.

Last year our consumption of crude oil totalled 531,186,000 barrels. Up to date we have withdrawn from our underground pools 40 per cent of their contents, so it is estimated; and at the present rate it is plain that it would not take us more than fifteen years to exhaust the 6,720,000,000 barrels of oil still remaining in our subterranean sands—*provided we could achieve a one hundred per cent. recovery.* But the outlook is even more disquieting, for we are authoritatively informed that the prevailing methods of mining the oil leave quite 50 per cent of it far down in the earth when the pumps cease to be effective.

Manifestly, it behooves us to better materially the ways and means by which we work our oil fields; and some of the best minds of the country are concentrated upon the subject. The experts of the U. S. Bureau of Mines have considered this economic problem from numerous angles, and latterly there has been evolved through the collaboration of several of these men an apparatus that is likely to prove of the greatest aid in utilizing nature's forces below ground so as to promote a fuller withdrawal of the petroleum stored there in the ages gone.

Heretofore, little has been published and few investigations have been made regarding the ultimate amount of oil which a property might be expected to yield, and the rate of the output has been a matter of mere conjecture. The producer gave scarcely any thought to such considerations—his main aim being to obtain as quickly as possible as much of the petroleum as he could from his wells. For a goodly period virgin territory remained available for exploitation, but these promising areas are dwindling fast, and because of this situation the American oil industry has come to an era that compels a more scientific and a more conservative procedure. Success in this departure will depend upon a broader grasp of subsurface conditions and their interrelations.

Experience has revealed to the trained oil technologist that gravitation and the pressures exerted by neighboring volumes of gas and bodies of water, in connection with the make-up of associate geological formations, determine how petroleum will migrate toward or away from a well when the dome or pool has been pierced by the exploratory drill. But until recently the exact reactions provoked were debatable and the theorists were by no means in complete accord. Today, thanks to ingenious laboratory apparatus that have been devised, various mute questions have been settled and much has been brought to light that can be applied to advantage in working any prescribed oil-bearing area.

As has been aptly said, there are two sets of influences which may regulate the productivity of a well—these are natural and artificial. Those of nature's making are the oil content of the reservoir rock or sand; the resistance to the movement of the oil through the materials holding it; the expulsive forces available; and the degree of effectiveness of these forces in driving the oil from its resting place. The chief artificial factors are the manner of operating the wells; the way they are spaced in relation to one another; and the application of processes to stimulate the subterranean transition of the oil for the purpose of bringing it within the reach of the recovering apparatus.

And then, by way of adding to the complexity of the problem, the actual amount of oil that may be carried in a "pay streak" depends upon the thickness, the porosity, the extent, and, not infrequently, the degree of saturation of the sand. Further, the quantity of oil that can be extracted by the operator may hinge upon the viscosity of the petroleum and the size of the sand grains lying in its course. The natural expulsive energy is that developed by the dissolved and the associated compressed gases; the direct pressure exerted by contiguous water; and the action of gravity. Gravitational migration, as understood in this connection, is the effort of the lighter oil to surmount the heavier water—a change of position which may or may not facilitate the yield of a given well.

In order that these several variables may be brought into play at will and observed over suitable periods of time, Mr. R. Van A. Mills of the U. S. Bureau of Mines has perfected a type of boxlike steel tank, provided with a heavy plate-glass front. Two sizes have been constructed for research work. The smaller pattern is 36.22 inches long, 18.9 inches high, and 3.54 inches deep from front to back; and the large tank is 72.24 inches from end to end, 48.82 inches from top to bottom, and 5.24 inches through. The small tank has a capacity equal to 10.49 gallons, while the larger design has a capacity of 79.94 gallons. The thickness of the face plates, which are removable, is contingent upon the pressures to be exerted within the apparatus during experiments. Either the cover plate or the heavy glass is taken off to arrange the materials for a test; and the character and the disposition of these are determined by the geological problem under consideration.

At corresponding elevations on each end, at points along the bottom, and at two places on top, each tank is tapped and provided with valves and connections through which air, oil, and water can be admitted. The air is used to represent natural gas, and, like the water and oil, is introduced at any desired pressure. The two top connections simulate neighboring wells; and their juxtaposition makes it feasible to trace the influence of one upon the other under different operating circumstances. These taps enable the investigator to introduce fluids as he may wish and to cause them to travel either horizontally or vertically by opening outlet valves at appropriate points. Again, the facilities at his disposal are such that he can induce the currents to assume a jet-like flow and at predetermined velocities, or by the employment of suitable baffles, current movements can be prevented.

The auxiliary equipment includes tanks for oils, water, and gases, if such be needed, and a reservoir charged with compressed air. There are, besides, meters of different sorts, gauges, thermometers and pressure regulators. A particularly interesting feature of this laboratory installation is the formation of artificial sandstone within a tank. This enables the scientist, by the employment of chemical reagents, to convert loose sand by cementation into a body approximating

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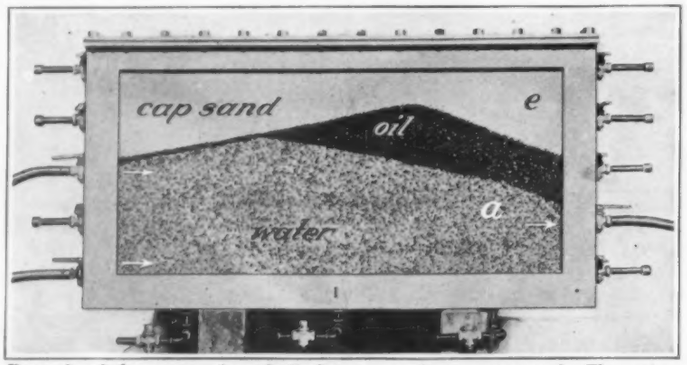
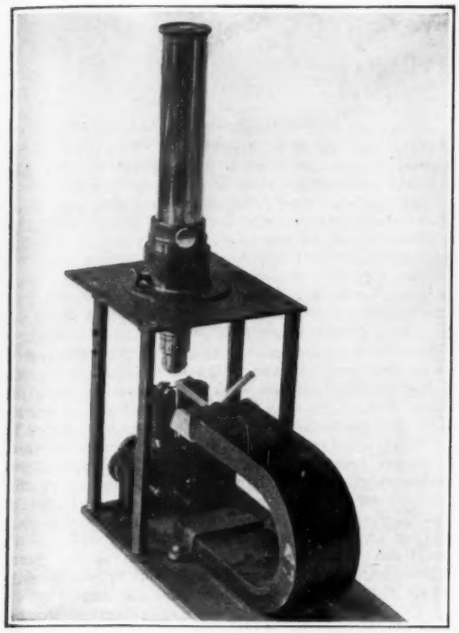



**Example of the segregation of oil above water in a porous sand. The water, somewhat salt, was forced in from the left and allowed to drain off at the right**



An extremely sensitive form of vibration galvanometer which is free from external tremblings

## Making the Most of the Vibration Galvanometer

BEING portable, sturdy and free from external tremblings, a new form of vibration galvanometer designed by P. G. Agnew of the Bureau of Standards may establish itself as a serviceable instrument for industrial laboratories as well as prove valuable to central electric stations in testing transformers in the power house and afield. The extreme sensitiveness of the prevailing types of vibration galvanometers has precluded the expansion of their uses.

The recently built instrument is of the moving-iron type as differentiated from the moving-coil form of vibration galvanometer. Essentially, the device consists of a fine steel wire mounted on one pole of a permanent magnet, its arrangement permitting the free ends of the wire to vibrate between the poles of an electromagnet through which the current to be detected passes. It operates under the principle that if an unmagnetized steel wire is held near the pole of an electromagnet, the end of the wire will vibrate with twice the frequency of the current.

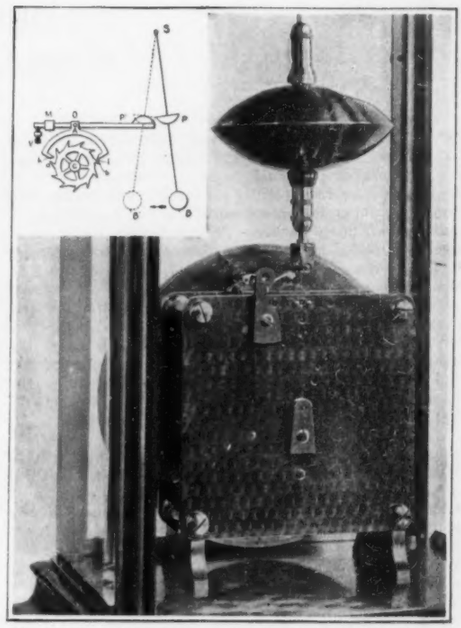
If the wire be magnetized by mounting it on the pole of a permanent magnet, the free end of the wire will be alternately attracted and repelled by the magnet; that is, the wire will vibrate with the same frequency as that of the current. Of more importance, the alternating mechanical pull will be very much greater than with an unpolarized wire, because the total flux is much greater. The permanent magnet plays the same role in increasing the motion of the wire that a similar magnet in a telephone receiver does in increasing the motion of the diaphragm.

With a magnifying power of 50 to 100, satisfactory under working conditions, a motion of the vibrator of five microns is readily discernible. With a 270-ohm winding the sensitivity is such that a current of 0.05 microampere can easily be detected. The virtues of the new form of vibration galvanometer, according to the inventor, are its freedom from external vibration, quick responsiveness, sturdiness and ease of adjustment.—By *S. R. Winters.*

## A Detached Escapement for Clocks

MOST of us do not interest ourselves particularly in the intricate little mechanism which we wear on our wrists or in our pockets. To the average person the word "escapement" means nothing very definite. The escapement, however, is a most important element. There are four main parts to a watch or clock: the motive power, which may be a weight or a spring; the train of wheels, or "works," operated by the motive or driving power; the agent for controlling the movements of the train—this part, in large clocks, is usually a pendulum, while in small clocks and watches it is a hair-spring balance; and the escapement, that part of the mechanism by which the pendulum or balance-wheel receives at each stroke the impulse necessary to keep it going at uniform pace, and overcome its tending to die out.

Monsieur Ch. Fery, a professor at the School of Physics and Chemistry at Paris, has invented a novel escapement which has proved to be most satisfactory and is a valuable contribution to horology. A beautiful little clock designed by M. Rodanet and equipped with this new detached escapement took first prize at the recent Pierret competition. We show here a photograph of the clock, and a line-drawing depicting how M. Fery's device works. The escape wheel, *C*, is mounted on the shaft of the last cog of the driving train. As it turns, the split arm, *A*, pivoted at *O*, lifts a lever provided with a counterbalance, *M*, which forces one end of the lever to rest on the screw, *V*, during the stops of the escape wheel; on the other end is a rounded weight, *P'*. On the pendulum is another part, *P*, equal in weight and similar in form to *P'*, which pushes the lever down in its horizontal passage. At the moment when the pendulum rests on the end of the lever, the weight *M* is lifted; the curved arm, *l*, touches the cog of the wheel, *b*, and is pushed upward. Once the pendulum has swung back, the end of the lever, *P'*, lifts with the combined effort of the weight *M* and the pressure of the cog *b*; and the other curved arm, *k*, coming in contact with the cog *a*, is pushed upward. In this way the pendulum is propelled; but the force given it is controlled by the two curved arms and is independent of the weight *M*. In this new escapement the vibrating system undergoes first a retarding action, then after its release it receives a much stronger accelerating impulse. A close comparison of the movement of a pendulum governed by the usual detached escapement with one governed by the Fery escapement shows a greater amplitude, or length of oscillation or vibration for the Fery escapement. M. Fery's is a clever device.—By *C. M. Lewis.*



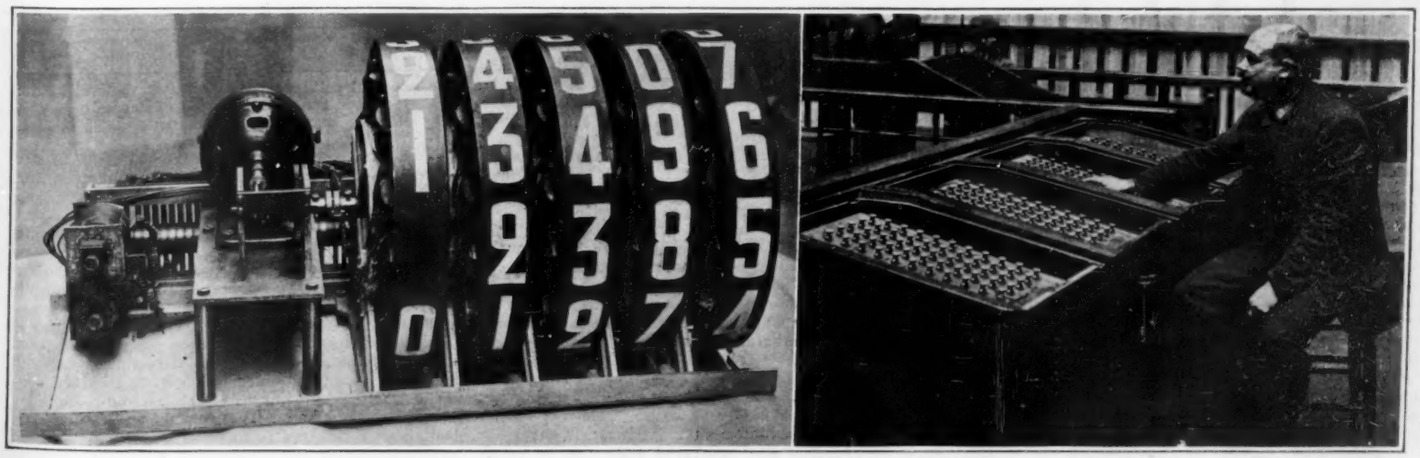

New form of escapement developed by a French professor and its principle of operation

## Stock Quotations at the Mere Push of a Button

AN ingenious system of posting stock quotations has made its appearance on the Paris Bourse—the Wall Street of France. By means of a push-button keyboard, an operator can post any stock quotations on the boards in plain view of the traders. Obviously, this is a marked improvement over the usual manual method of posting quotations by means of cards or slides, and it is more expeditious by a good margin.

The French stock-quotation indicator consists of a motor-driven machine which carries five indicator wheels, on the periphery of each of which are stenciled the numerals from 0 to 9, with one space left blank. The motor drives these wheels through suitable reduction gearing by means of an electromagnetic clutch.

The principle of operation is simply to spin the five wheels and then, by pressing certain push-buttons, to energize one electromagnet in each of the five batteries of electromagnets. Each battery of electromagnets consists of eleven solenoids, mounted on the stationary frame of the device within its indicator wheels. By means of an armature operated by the energized electromagnet, each wheel is stopped at the desired point, so as to bring the desired numeral into position behind the window. Each wheel carries a lug inside the rim, which engages with any one of the eleven electromagnetically-operated armatures which acts as a stop. The operation is quite rapid and positive.—By *Ralph Howard.*



*Left:* Mechanism of the electrically-operated stock-quotation board employed in the Paris Bourse, showing the electric motor, reduction gearing, and the five wheels which carry the numerals. Note the electromagnets mounted within the wheels but which are held on a stationary frame. These electromagnets operate armatures which, in turn, engage with a lug inside each wheel and bring it to a stop at the desired point. *Right:* Push-button board and the operator. These buttons serve to energize the necessary electromagnets of the stock-quotation board so as to post the necessary figures

The two ends of the electrical stock quotation board used on the Paris Bourse

# Starving In the Midst of Plenty

## Present Knowledge Regarding the Cause and Cure of Pellagra

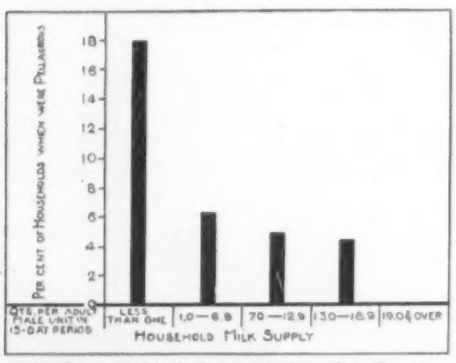
By Robert G. Skerrett

THE social and economic sacrifices entailed in the loss of 10,000 lives in the course of a single year are matters of profound moment. The U. S. Public Health Service has recently declared that pellagra will levy a mortality to this extent among the inhabitants of thirteen of our Southern States during the current twelve months. Indeed, for a decade and more, pellagra has stood out as one of the foremost causes of death in the region in question.

But this is not the whole of the story. It seems that probably 100,000 persons will be affected by the disease in 1921, and unless steps are taken to arrest the malady many more will be afflicted with it next year. Apart from the fatal cases, we must recognize the financial and productive losses due to the sickness or the invalidism of tens of thousands of people.

Pellagra has been known to the medical fraternity since 1735 when it was first discovered in northern Spain. Two decades later the disease was identified in northern Italy, where it has been endemic ever since; and it appeared in southwestern France to a pronounced degree about 1820 during a period of extreme poverty following in the wake of the Napoleonic Wars. At that time the people at large subsisted as a rule upon a diet made up of cereals, fat pork, and but a scanty allowance of fresh vegetables. In Italy, for a long while, pellagra was ascribed to the continual eating of much maize; and the prevailing belief abroad fifteen or twenty years ago was that it was the consequence of eating spoiled corn porridge.

Pellagra was not observed in this country to any extent until about 1908, but its rapid increase in the South thereafter reasonably occasioned alarm and led to both State and Federal investigations. The work of the U. S. Public Health Service in this field of inquiry has been of a notable character, because the experts have established conclusively how pellagra can be cured as well as prevented. The problem resolves itself into a question of diet—one sufficiently diversified to contain a proper proportion of the food elements essential to satisfying all of the needs of a vigorous body. And once more it is made plain that we may eat enough of wholesome food to gratify the appetite and yet induce grave physical disturbances by reason of the unbalanced nature of the diet.

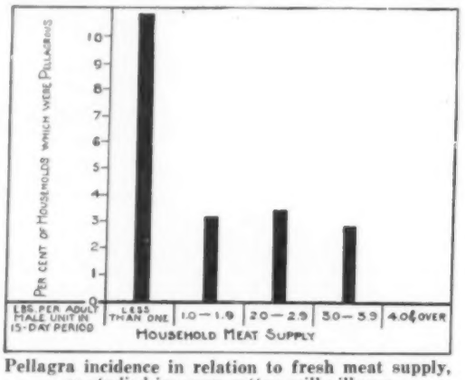



**A further graphical demonstration, for the same villages, of the relation between milk supply and freedom from pellagra**

The studies that were taken up by the U. S. Public Health Service in 1913 were centered principally in South Carolina and were finally brought to a focus in 1916 in seven cotton-mill communities in that State. The researches were restricted to the families of the white portion of the population composed well-nigh exclusively of native-born Anglo-Saxon stock. It was found that out of a total of 4399 persons the incidence rate of the disease was 42.7 per 1000. Repeated and systematic questioning of the dwellers in each household brought out the fact that pellagra was uniformly in evidence among those who subsisted mostly upon cornbread, biscuits made from white flour, grits, gravy, and syrup, and who consumed little if any lean meat or milk. They were relying on cereals, starches, and fat, and denying themselves foodstuffs rich in protein.

A short while before this intensive survey of the cotton-mill villages, Dr. Joseph Goldberger and some of his fellows of the U. S. Public Health Service carried on a series of dietary experiments among the inmates of certain State institutions. At one of them eleven volunteers were fed during an interval of six months upon a restricted diet made up of bolted wheat flour and cornmeal of good quality, polished rice, sugar, pork fat, sweet potatoes, and relatively small quantities of cabbage, collards, and turnip greens. In the course of five months six of the subjects developed pellagrous symptoms. As will be seen, this diet was deficient in foods containing protein. Dr. E. V. McCollum, of Johns Hopkins University, has obtained similar results in feeding the same food to rats.

The cumulative evidence of the part played by a




**Pellagra incidence in relation to fresh meat supply, as studied in seven cotton-mill villages of South Carolina**

lack of protein in promoting pellagra was further emphasized when youthful patients from pellagrous households were given a properly rounded or balanced diet. These under-nourished little ones were quickly cured by the corrected diet and, what is equally significant, they became stronger and better physically than they had been prior to developing the disease. For we are now very certain that sanitary circumstances are not connected with the incidence of pellagra as is the case with typhoid fever. Further, we are positively assured that pellagra is not a communicable disease. No one will have it if he eat foods containing the elements essential to all of the bodily functions.

The people of the South are the principal sufferers because of their dietary habit. It is well known that they partake much less of animal foods, such as lean meat and milk, than is usual in other sections of the country. One explanation of this is that the South generally does not raise much livestock and the dairy herds are notably undeveloped by comparison. Therefore, fresh meat and milk are rather high-priced commodities, and in the small towns and rural districts the supplies are somewhat limited. Naturally, any economic disturbance makes it harder for the poorer citizenry to buy these foodstuffs. This is the situation today.

Nearly sixty years ago an eminent Frenchman made this observation regarding pellagra in the endemic area of southern France: "Shepherds are almost all pellagrous; cowherds are hardly ever such. They have the same occupation, the same manner of life, but the cowherd nourishes himself in large part with milk." And milk, as we are informed, is rich in protein. Taking the nation by and large, the average daily consumption is half a pint of milk per capita. While the consumption per person in the favored parts of the country is considerably greater, in the South, however, the fresh milk supply in many communities is at the rate of little more than half a gill per individual! This state of affairs makes it easier to realize why pellagra has such a hold in the far-flung region lying to the south of the Ohio and the Potomac Rivers.

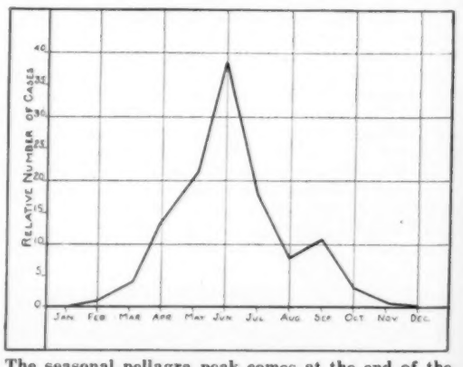
According to Dr. Goldberger, milk is the most important single food in balancing a diet and in preventing or curing pellagra. He tells us that if, for any reason, lean meat, fruits and green vegetables can be had only in very small quantities, then not less than 1½ pints of milk should be drunk daily. This may be in the form of fresh or buttermilk. However, if either of these be not available, preserved milk can be used instead; and during the experimental work in the cotton mill villages of South Carolina, one pound of canned milk was considered equivalent from a nutritive standpoint to one quart of fresh milk. This fact is of especial significance now in view of the relief measures which are likely to be undertaken shortly.

Lean meat, such as fowl, beef, pork, fish, etc., is of much help in balancing a diet in the absence of milk; and there should be provided quite half a pound of this foodstuff three or four times a week. This meat allowance may be reduced somewhat if the difference be made up by substituting eggs or cheese. Indeed, so we are authoritatively informed, the only cure that we have for pellagra today is a correct diet. And when this remedial agency is brought into play betterment of the patient is noted, even in severe cases, in the course of from ten to fourteen days! But recovery from an attack does not insure permanent relief unless a balanced diet be held to thereafter. Otherwise, there is apt to be a recurrence of the disease sooner or later.

Pellagra is seasonal insofar as the incidence of the disease reaches a maximum at the beginning of the summer. In the Southern States the malady attains its peak in the month of June; and as one of the accompanying graphs shows there is a steady drop in its prevalence from then on to the close of the year. This indicates, as has been brought out by our investigators, that during the winter and the early spring the victims live too much upon a pellagra-producing dietary. As a consequence, the disease reaches its climax just about the time that fresh vegetables and other produce of the farm begin to be plentiful.

It is found that pellagra is rare in children up to two years old—throughout that period in fact, when milk normally constitutes the chief source of nourishment. Among males and females the incidence is similar until they reach twenty, and in the case of the youthful the malady is more frequent between two and ten than between ten and nineteen years, inclusive. Clearly, the markedly formative period of childhood demands a full measure of protein, and milk rather than meat would seem best fitted to supply this need and the other dietary elements essential to body building. Among adults the incidence of pellagra is much higher in women than in men.

The most tell-tale characteristic of the disease is a distinctive eruption appearing simultaneously over the same area on both sides of the body. This may involve




**The seasonal pellagra peak comes at the end of the winter and spring period of dependence upon stored foods**

both elbows, both cheeks, both knees, etc. At first the eruption is not unlike sunburn, but later the affected skin assumes a parchment-like texture, then grows rough and scaly, and is likely to crack or peel. At the same time there are digestive and nervous disturbance. The sufferers lose strength, may become delirious, and when the disease is in an advanced or aggravated stage, the victim may collapse and die suddenly.

The effects of pellagra are cumulative, from year to year, in persons that return season after season to an unbalanced diet. Relief during the summer and fall months is deceptive, and each succeeding attack adds to the gravity of the physical condition and reduces the powers of resistance. The fundamental problem in dealing with pellagra is to bring about a widespread understanding of the necessity of a balanced diet at all times; and if this lesson be learned and applied we shall stamp out pellagra here just as was done decades back in France.

# Proposed Hudson River Pontoon Bridge

## An Emergency Measure to Meet Severe Automobile Congestion

THE pontoon bridge, in which boats or barges take the place of piers, is a form of construction which not only has the sanction of centuries behind it, but today it is used extensively for crossing important rivers in Europe. Notable instances of this are the pontoon bridges across the Rhine at Cologne and Coblenz.

It might be supposed that the obstruction to traffic would be very severe; but the Rhine bridges seem to have functioned satisfactorily, although that river carries, and has carried for many years, an exceedingly heavy traffic both by barge and steamer. In the case of the Rhine bridges, provision is made for the passage of river traffic by hinging a section of the bridge so that one end of this section can be released and allowed to swing downstream. Means are provided for hauling the swinging bridge back into position after the shipping has passed through.

It is now proposed to utilize the pontoon method of bridge building on a very extensive scale by a crossing of the Hudson River from Yonkers to Alpine. The width from shore to shore is 5700 feet, and the length of the pontoon bridge between the trestle approaches will be about 4800 feet. Provision will be made for the passage of Hudson River steamers by building some form of drawbridge, probably of the lift type, across the main channel of the river. There will be enough clearance between the water and the underside of the bridge to permit of the passage of river tows and the smaller craft, without opening the drawspan.

### How the Suggestion Originated

The proposal to build a pontoon bridge at this point came first from Major W. A. Welch, Engineer of the Palisades Interstate Park Commission. At present, because of the utterly inadequate facilities for getting across the river, the park is comparatively inaccessible to millions of New York City people. The matter was suggested to the Major by the application of the Shipping Board for anchorage privileges, for idle wooden ships, in the Hudson River waters adjacent to the park. Major Welch suggested the use of the ships for a pontoon bridge to Mr. Otis H. Cutler, who is Chairman of the Hudson River Bridge Corporation, and he submitted the idea to Mr. Gustav Lindenthal, the designer of the Hudson River Bridge. The undertaking was found to be entirely practical; in fact, Mr. Lindenthal had proposed the construction of a pontoon bridge across the Delaware at Philadelphia to assist the movement of military supplies during the war. This bridge would have been built but for the intervention of the armistice.

The bridge at Yonkers will, of course, be an emergency bridge, built to give temporary relief to the unimaginable crowding of automobiles, which is heavy on any day of the week and unbelievably bad (by those who have not witnessed it) on Sundays and holidays. It is nothing unusual to find one's self on the western side of the river, or on the eastern side for that matter, with a string of automobiles *miles* in length between one's machine and the ferry; and a wait of several hours is a usual occurrence at these times. The pontoon bridge, which Mr. Lindenthal says can be built in less than a year, at a cost of two million dollars, will afford immediate relief a dozen miles to the north of New York City, and will ease up the crowding of the New York ferries very materially.

### Principal Dimensions of the Bridge

The plans call for a series of steel trusses 160 feet in length, which will be carried by steel A-towers rising from the decks of the ships, which will thus take the part of the usual piers. There will be four lines of trusses each ten feet in depth, upon which will be laid a wooden flooring with a total thickness of 12 inches. The width out-and-out of the trusses will be 30 feet, and the width overall of the floor will be 40 feet. Thirty feet of this will provide a roadway sufficient for three lines of automobiles, and adjoining this will be a 10-foot sidewalk for foot passengers. The steel towers or piers will be erected at the middle of the ship, and each tower will consist of four braced bents with their posts battered in the direction of the axis of the bridge, the width being 20 feet where they rest upon the deck of the ship, and three feet at the top, where they receive the ends of the steel spans.

### The Ship Pontoons

The wooden ships which will be taken over from the Shipping Board will be about 40 in number. They are of what is known as the Ferris type, 281.6 feet in length by 45.2 feet broad. When the bridge is completed, the underside of the trusses will be about 40 feet above the water. The ships will be very securely anchored either by massive anchors sunk in the river bottom or by massed piling driven ahead and astern of the ships. It will readily be understood that because of the great size of the ships, the secure manner in which they will be anchored, and the absence of any waves sufficient to cause any roll or scend of the ships, the bridge, to all intents and purposes, will be as rigid as one whose piers reached to the river bottom. Furthermore, because of the length of the ships, it will be possible in the future to make a very quick and comparatively inexpensive addition to the capacity of the bridge by erecting additional towers and steel spans adjoining those at present proposed.

# The Captive Helicopter

## Details of the Remarkable Machine Developed by an Austrian Army Officer

SOME time ago we had something to say regarding the remarkable captive helicopter developed by Lt. Stefan von Petroczy of the Austrian Army Balloon Corps, which was built and tested during the war. It has been our good fortune to obtain further data from British official sources regarding this captive helicopter which has made several flights, and we have had our artist prepare the present cover painting, using as a basis the rough sketches of the Petroczy helicopter which have come to our hands.

The first tests were made at the Austrian Airplane Factory, Ltd., Wiener-Neustadt, with propellers of rather large diameter. The captive helicopter, fitted with gasoline engines, consisted of a three-armed frame made of steel tubes, in which three reconstructed Le Rhône engines of 120 horsepower each were mounted. The engines drove two propeller shafts, revolving in opposite directions by means of a transmission gear, and these propeller shafts in turn drove two wooden propellers, each 20 feet in diameter, at about 600 revolutions per minute. Three petrol tanks were installed near the motors. The entire system was supported by a large buffer, which was kept tightly filled with air through an air-pump driven by the engines; under the end of each arm three small buffers were similarly disposed. The object of these buffers was to reduce the shock in abrupt landings. The observer's seat, made of veneer, was situated over the propellers and strongly secured to the stationary gear-case by the concave interior propeller shaft. A machine-gun turret was located on the upper rim of the observer's seat. A parachute was fitted beside the observer. It had an area of 2690 square feet and was intended, in case of sudden stoppage of the motor, to bear the weight of the entire installation, including the observer. The parachute was to operate either automatically or under control. Automatically the parachute operates in such wise that when a regulator adjusted for the purpose falls below a certain number of revolutions of the propeller it releases a mechanism which ejects the parachute. This ejection from the center causes the parachute to open instantly and tests have proved that it begins to work after a drop of about 80 feet. This device thus ensures the captive helicopter against damage, in case the engines should stop at low altitudes. The same mechanism brings the motor to a standstill at the time of ejecting the parachute. The parachute may also be worked by hand by the observer, who is furthermore provided with a pack parachute for personal safety. A need for the use of the parachute occurs only when at least two engines have stopped, two engines being capable of maintaining the propeller at a sufficiently high rate of revolution.

The climb takes place as follows: When the observer has taken up his position, the engines are started, and this creates no difficulty by reason of the fact that *one* engine at work causes the others to revolve. The functioning of the motor can be controlled by the observer, and future types of the captive helicopter will have the necessary instruments located within reach of the observer. As soon as the engine has attained the full number of revolutions, a signal will be given for the loosening of the winch and the machine will then, according to present experience, climb at a speed of about 4 feet per second. This climbing speed mainly depends upon the pitch of the propeller and the direction of the wind, and it can, therefore, be considerably increased. The captive helicopter is brought down by reversing the winch.

Up to date, the engines have always run at full intake, in which case the excess of lift must be compensated. In future, the engines will be throttled in order to diminish the work of the winch. The total weight of the captive helicopter, with engine and fuel for one hour, but not including the observer and the machine-gun, is about 2900 pounds. It is strongly constructed and some slight lessening of weight may yet be attained. At the start the total weight lifted was about 4000 pounds, that is, about 11 pounds per horsepower. This can be considerably augmented by enlarging the propellers. The original type of captive helicopter driven by gasoline engine power was manufactured by the firm of Dr. Liptak, Ltd., Budapest-Szentlörincz under the special supervision of Professor Karman's collaborator, Lt. Eng. W. Zurovec, and the above-named firm owns their patent.

The reports of the test-flights undertaken may be summed up as follows:

From April 2 to 5, lift and stability tests at low heights, duration tests up to 60 minutes.

From May 17 to June 10, climbing to from 30 feet to 160 feet altitude. Results: Lift excess on the ground to a load of 4 men. Perfectly tranquil soaring at an altitude of 160 feet. Wind velocity during tests up to 26 feet per second. The general outline of this machine will be made clear by our cover, showing it in full flight. After about fifteen successful flight tests, the machine had a breakdown when landing on June 10. The power of the Le Rhône engines, which had been recently repaired, decreased so considerably that there was an insufficient excess of thrust, and the machine therefore oscillated violently, especially while being brought down. The crew abandoned it, and the machine turned over on the ground, the propeller blades sticking into the earth. Considering the state of the motors, Professor Karman and Lieutenant Zurovec had wished to omit the tests (there being a wind velocity of 26 feet per second), but they were urged to carry them on by the testing commission, as a result of which the machine was wrecked. The results fully confirmed those already arrived at with model tests, so far as stability is concerned. Observation made in the wind proved that, in addition to the fundamental demand for ample excess of thrust, the position of the center of gravity of the machine in its relation to the plane of rotation of the propeller is of great importance. The results obtained in that respect, both in theory and by means of practical tests, should be of the utmost value as applied to the details of construction of a second type.

# Enemies of Timber Construction

## Some of the Insects that Prey on Piles and Beams, and the Extent of Their Depredations

By J. F. Springer

OF all the forms of life which attack and destroy the integrity of timber construction, perhaps the *teredo* is entitled to the greatest notice. This little mollusc works below the water, most often perhaps at the mudline, entering a timber through a minute hole at an early age and then continuing his operations upon the interior. Because of the smallness and location of the entrance aperture and the damage done when beyond observation, teredos may accomplish a very extended and serious amount of damage before anything wrong is detected. Besides, only a few species of wood are proof against this activity. As submerged timbers, especially piles, are used as the foundation of many marine structures, it may be granted that the activity of the teredo may become dangerous as well as expensive. Just before the Great War—that is, in 1913—the Manati Sugar Company built a marine pier in the Bay of Manati on the north coast of Cuba. In five years, in the spring of 1918, part of the pier failed. In order to keep up sugar shipments, quick work had to be done by way of repairs. But after this, the pier was examined in what appeared to be good and undamaged parts. Certain piles had broken in two. They were found to be seriously honey-combed by some boring form of life, the principal damage being apparently in locations that had been in deep water and at or near the mud line. Eight piles were pulled which were thought to represent fairly the remaining stand of apparently good piles. All of them gave way, breaking at the mud line. Evidently, the whole pier had, so far as its foundation was concerned, gone to pot in five years. The piles were of Cuban hard wood. Undoubtedly, the teredo was responsible for this destruction. What has been illustrated by this case is representative of the depredations of this mollusc everywhere.

The teredo is familiarly known as the "ship worm." Once having entered a pile or other timber, the teredo is understood never to come out again. It follows the grain of the wood, as a general thing, and one teredo burrow hole never breaks into another. If, in the course of its burrowing activity, it comes too close to another burrow, it alters its course to pass. Great numbers may inhabit a single pile, and cut its interior in the infested zone to more shreds of wood. Still the pile may stand and present the general appearance of soundness. The burrow may attain diameters up to ½ or ¾ inch in the higher parts. The hole is lined with shell. But, usually, a short length at the top is left uncoated. Sometimes, however, the lining covers the full length, the inner end then being hemispherical.

The head of the teredo lies in the inner end of the burrow. An adult may be only a few inches long or it may measure a yard. It depends on the particular species. There is a pair of shells at the head. These are triangular in outline and quite concave next the animal. Just how the boring takes place is apparently unknown. It has been conjectured that it results from operating the shells. Thus, the teredo has been thought to use a sucker-like foot at the head end as a means of fixing itself and then cut the woody fiber with a rasping action of the shells. Another opinion makes the boring action due to a solvent secreted from the surface of the teredo. Still another thought is that the teredo gets ahead in its burrow by means of silicious particles imbedded in the skin in front of the shells. But some scientists say that there are no silicious particles nor solvent acid secretion. One expert believes the foot already mentioned is the real boring tool. Another animal, the *pholas*, has been actually observed to bore with shells, a sucker foot being used as a support. Against this theory, in so far as the teredo is concerned, is the presence of an epidermis on the shells, which it is thought could hardly be present if they were used as rasps.

**Experimental piles removed from California waters in 1913. The borers and their ilk have left little enough of the big sticks**

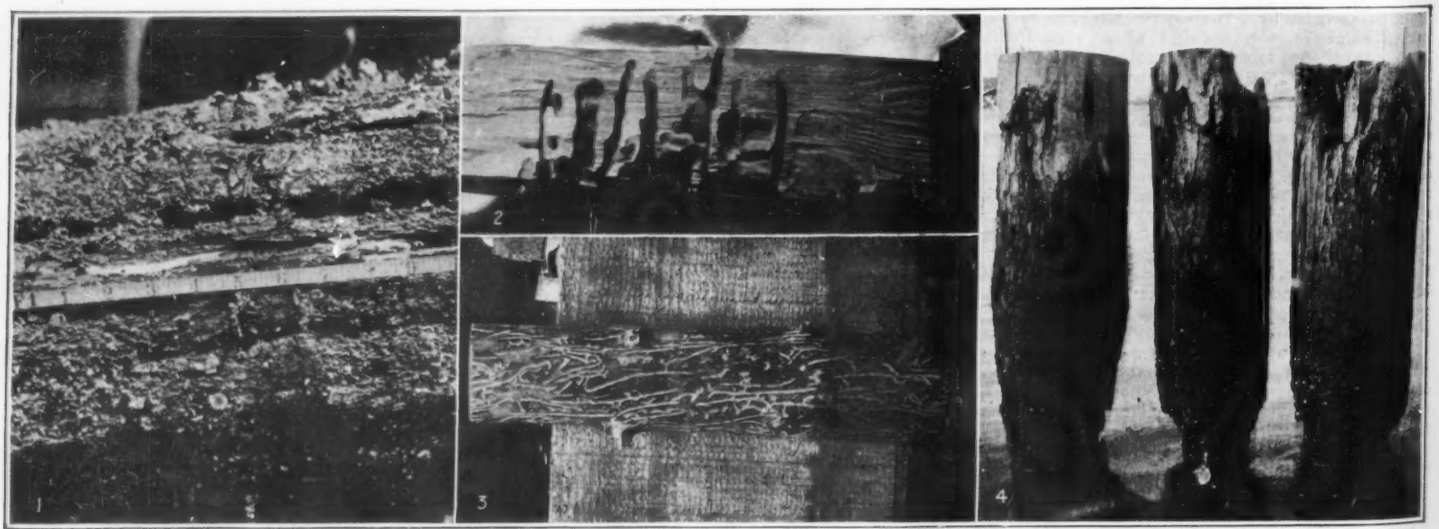
The teredo may operate with some rapidity. One of the older naturalists tells of a ferry-boat accidentally sunk in the spring and raised again after four months. The wood had already become useless. This was on a northern coast of Spain.

Some woods are believed to be proof against the teredo. Sneezewood, found in Natal, South Africa, is claimed as immune. It has been considerably used in marine work. Jarrah wood is also claimed as suited to marine construction on the ground that it resists better than any other wood the *teredo navalis* and other boring animals. When used on land in the tropics, this wood is said to be equally good as a resister of the white ant. It is found in the southwest of Australia, and nowhere else than in Australia. There is a good deal of it there and it grows to goodly sizes, sizes big enough to give a timber 2 x 2 feet in section and 40 feet long. It has the same specific gravity as water. However, it has the bad quality of breaking rather easily, there being a deficiency of fiber.

The teredo is, however, not the only marine boring animal. A very similar type is known by the name *xylotrya*. This is also a mollusc. The eggs are laid free in the water. These hatch to form swimming larvæ. They are at first free in the water and are said to attach themselves by a foot to a timber and then to bore their way in. The tubular holes are lined with calcareous material. The diameter of the hole is, on the average, about ⅜ inch; but it may run up to 1 inch. The length may be in the general neighborhood of 4½ inches; but a maximum of 12 inches or even more is sometimes attained. This little mollusc is so small when it enters that the perforation is like a pin hole. Inside, however, the diameter grows with that of the animal itself. The galleries are said to be closely intertwined and very numerous.

The *limnoria*, commonly known as the gribble, is a very small isopod. This animal is supposed to gnaw or bite its way into the pile or other submerged timber. The body is somewhat flat and there are numerous legs. The depredation consists of a hole 1/32 to 1/16 inch in diameter directed perpendicularly into the timber. The depth of the hole will be, say, ½ inch. Between adjacent holes, the partition left is quite thin, so that they pretty effectively destroy the wood to the depth of the penetration. The limnoria infests both the

*(Continued on page 123)*

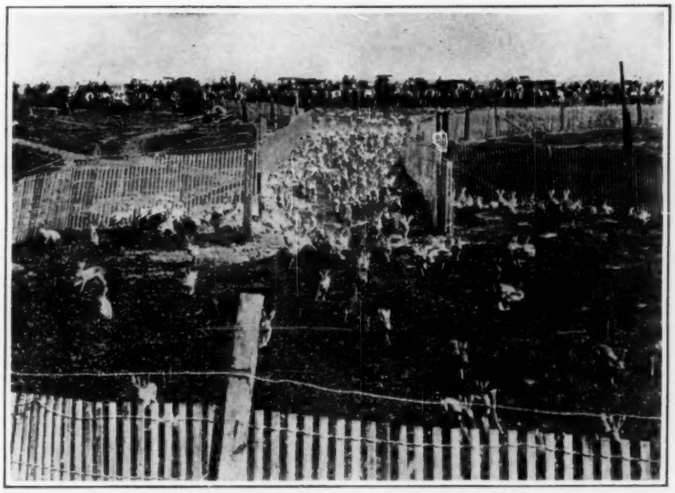


1. A teredo burrow in an experimental pile of Lawson cypress, after one year in sea water. The teredo got too near the surface, and backed up two inches to work farther towards the interior of the stick. 2. Galleries of the carpenter ant carved out of cedar. 3. The work of Ips confusus on young yellow pine. 4. Piles of a 15-year-old oyster-house, eaten up by worms and abandoned

**The work of the teredo and other enemies of wood, both in water and on dry land**

## Idaho's Rabbit Drive

EVERYBODY has heard how the rabbit after he was deliberately introduced into Australia, multiplied to such an extent that within a comparatively few years he became a pest, and had to be put down at a cost of many millions. It appears that the irrigated districts of our own West are subject to the same trouble, though in this case they are innocent of having brought their own woes upon themselves. Readers of the early western classics will doubtless recall numerous authors who have repeated the yarn about walking across the prairie on the rabbits without ever stepping on the ground. The present picture gives some indication that this may not have been altogether an exaggeration. It comes from Minnidoka County, Idaho, where a rabbit drive is now in full swing, and 89,000 of the jacks have already been killed by the organized efforts of the community. The picture indicates sufficiently well the manner in which the rabbits that are to be found over a considerable expanse of territory are rounded up and driven into a corral, there to be dealt with according to the exigencies of the situation. We are rather accustomed to such tactics in dealing with horses, cattle, and other large animals; that they are effective with such a small and elusive creature as the rabbit may surprise us. In any event, it looks as though rabbit fur ought to be cheap for the coming season.



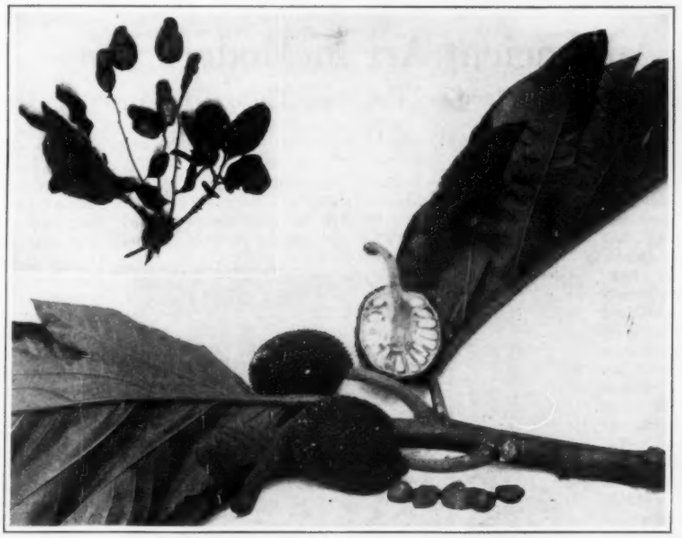
**How the western irrigation farmers proceed against the rabbit pest, which has come to a point where action is necessary**

## More Combination Fruits and Nuts

THE account of the two remarkable fruits given in the SCIENTIFIC AMERICAN of December 13, 1919—a smooth-skinned peach combined with an almond, and the "raisin plum" whose pit contains an edible kernel resembling a hazelnut in flavor—gave facts that should encourage enterprising horticulturists to make a feature of growing them in such parts of the United States as may have a favorable climate. It seems strange that while these fruits should long have been imported in a limited way comparatively nothing should hitherto have been known of them outside of the foreign residents of New York among whom they had their market. The nectarine, of course, is simply a smooth-skinned peach. But a nectarine that yields an almond into the bargain should be something worth anybody's attention.

The writer of the article, however, was in error in his assertion to the effect that these were the only known edible fruits that contained edible kernels. There are several others. One of the best known is the cashew; its delicious nut is constantly growing in favor and may be obtained very generally in our large cities. There are some most curious facts relating to it. The cashew nut is borne by the tree called *anarcadium occidentale*, of American tropical origin, but now grown in nearly all tropical countries. The tree belongs to a large and widely diffused family that includes the mango and the pistachio. The pistachio nut, by the way, is another instance of an edible nut, or seed, contained in a fruit. But whether the pistachio fruit is edible or not does not appear. The nut comes chiefly from the Balkan peninsula and is common at Greek and Italian fruit stands in the season though the native American's chief contact with it is usually in his ice cream.

The cashew gets its English name from a phonetic attempt at the French name of the tree, *acajou*, which in turn is derived from the Brazilian name, *acaciaba*. In Porto Rico and perhaps the other Spanish West Indies, where the tree is common, it is called *pajuil* (pronounced *pah-ichéel*). It is a handsome tree with a large glossy leaf. The blossom is insignificant, but deliciously fragrant. The relationship between the fruit and the nut of the cashew is so peculiar that it would, perhaps, be more in order to call the fruit the "fruit of the seed" rather than to speak of the nut as the "seed of the fruit." This because the nut, which is kidney- or bean-shaped, grows to full size before the fruit is formed. The long stem, or "hypocarp," of the nut then begins to swell and grows rapidly until it forms a pear-shaped edible fruit, half swallowing the nut which protrudes from the thick end, in a fashion most amazing to one who has never seen the species before.



*Large picture:* The breadfruit, which contains edible nuts imbedded in the edible flesh of the fruit. *Insert:* The remarkable fruit of the cashew tree, in which the edible nut of an edible fruit is attached to the outside of the fruit, which develops after the nut and partially surrounds the latter

**Fruit and nut in one; two examples from Porto Rico**

The manner of growth is not the only peculiarity of the cashew, as many have found to their sorrow. The shell of the nut contains a viscous and acrid oil, exceedingly caustic in character. The effect of this oil is similar to that of poison ivy upon persons with whom it comes in contact. The nut is roasted before it is sent to the market and the oil, evaporated by the heat, is expelled, leaving the nut harmless. But great care has to be taken in the roasting, for all persons susceptible to ivy-poisoning—and perhaps even others who are immune—are certain to contract a case of the most virulent kind if the fumes come in contact with them. Not a few persons who have had the raw nuts sent them by friends in the tropics without caution as to the importance of extreme care in the roasting, so that the fumes shall go either up chimney or be carried to windward, have had a bitter experience in this respect.

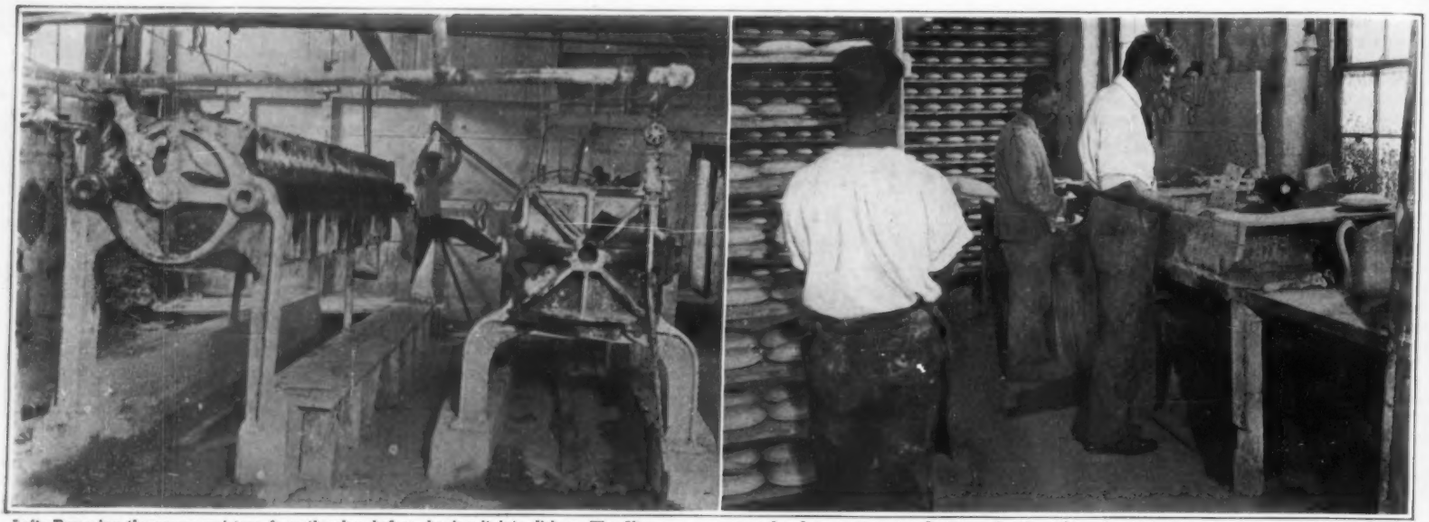
Another important edible fruit carrying an edible pit, or seed, is the mamey, or *sapote mamey*, a native of Mexico and other parts of tropical America. The tree is called the *mammea americana*. The mamey is a large fruit, taking two years to mature. The tree is very prolific and carries the fruit in all stages of growth, so that it is continually coming to maturity. The large single seed is often the size of a hen's egg. When dried and ground into meal this seed is highly nutritious and palatable. The fruit is substantial in flesh, much like that of a pumpkin when cooked; within it is of a rich orange or terra-cotta color. Its flavor is such that a New England visitor in Mexico called it "a sort of natural-born pumpkin pie." The seeds of the mamey are so large that a very few would make a pound. They could be so easily collected, and the tree is so fruitful, that it should be possible to grow the fruit systematically solely on account of the food value of the seed; moreover, the exceedingly sweet fruit is so rich in sugar that it might be made of no little service in that respect by extracting the juice and reducing it to syrup or perhaps converting it to sugar.

Yet another nut-bearing edible fruit is the famous breadfruit of Polynesia, borne by the beautiful tree called *artocarpus communis*, now grown in the tropics all over the world. The fertile variety of the breadfruit, beside its edible flesh, contains an abundance of nuts the size of a large chestnut. These, either boiled or roasted, are most palatable and nutritious. Thus treated they are often ground into meal.

## Overalls by the Bale

WHEN our new suit comes home from the tailor's, it is carefully folded and wrapped in innumerable layers of tissue paper, and the whole placed in an individual box of its own with every precaution that it shall not acquire a single wrinkle. But every style of wearing apparel is not handled with the same degree of circumspection. Our picture shows the rough and ready style in which overalls, for instance, are packed for shipment to foreign and domestic markets. They are pressed without ceremony into the smallest compass, and then done securely up in bales. Such treatment is altogether different from that accorded the noble dress suit.

**Where overalls are baled for shipment all over the world**



*Left:* Removing the excess moisture from the clay, before shaping it into dishes. The filter presses are made of compartments of strong sheeting, through which water escapes to the drain below. *Right:* Shaping the clay on molds, which remain inside the dish to support it while it is drying on the heated shelves of the background

**Two steps in the transformation that converts wet clay into handsome china**

# An Ancient Art in Modern Dress

## How the Potter Does, by Machine, the Same Things His Ancestors Did by Hand

By M. O. Goldsmith

THE first pottery was made by woman, back in the Stone Age. But man soon discovered the fascination of shaping vessels of this stuff of the earth we call clay, the only substance he has ever found that can be molded and made to keep its shape when baked. Johnnie and his sister, repeating the history of civilization out in the backyard, in due time reach the pottery stage and begin to mix and shape and bake mud pies. Johnnie never thinks of it as girl's play. Neither does Johnnie's father, the potter. He knows that the making of earthenware today is a man's job.

The outsider may imagine that pottery is a simple art—that a lump of clay goes into a machine and comes out a dish. It doesn't. There is hardly a step in the long process that doesn't depend on the workman's skill and care. In fact, the location of a pottery is marked not by the belching smoke and noisome odor that identifies other factories, but by the pile of ruins beside the wall—the smash and crash of some hundreds of broken dishes dumped out as pure waste, to be sold at a dollar and a half a ton to line the hearths of steel furnaces. All, perhaps, because at the moment when it was time to regulate the heat of the kiln, the fireman wasn't on his job. For a fireman can make or break a pottery.

All the output for a week, representing thousands of dollars, is fired at once in huge kilns two stories high, each holding perhaps seven thousand pieces. For two days and a half after the opening is bricked up and fires started, the heat gradually mounts higher and higher, the flames following the flues and wrapping around the oven and out again. There is no thermometer to tell when the critical temperature is reached, nor is there an automatic device to regulate the heat, as is found in a steel plant or rubber factory. Things are happening there in the kiln, chemical changes that never happen twice alike in time or temperature. It is the action of the heat on the biscuit, as they call the unglazed pottery, that is important. And no automatic devices can tell that.

Instead, through a peephole in the wall, the fireman watches three test cones of clay inside. You may wonder how he can stand the heat, but the walls are so thick and the peephole so small that there is no rush of flame in his direction. When the peak of cone No. 1 begins to tilt, he knows its melting point has been reached and he knows what stage in the firing that melting represents. No. 2 has a higher melting point and bears watching. But the tilting of No. 3 is a signal to stop stoking.

All this time he has not been able to observe the biscuit itself for that is tightly packed in big fireclay boxes, saggers. He is doubtless oblivious to the beautiful colors these rude saggers take on after much firing—a rich brown, shading off into copper and orange. His interest is in the contents. But their fate he cannot know for another two days. It would be disastrous if the kiln cooled down quickly and the biscuit contracted at a too speedy rate.

When the suspense is over he may discover that some of the saggers were not tightly caulked in the

**Stacking in the kiln the fireclay boxes filled with raw earthenware**

**The dipper, who has to determine instantly, by the feel of each piece as he picks it up, how much glaze it needs**

preparation for firing. Sulfur fumes from the coal have found entrance and ruined the contents by discoloration. Or, right at the start, a goodly percentage of the biscuit may have been doomed, if the man who mixes the clay, determining the different proportions by weight, failed to calculate correctly the varying amount of moisture in the raw clay and to alter his mixing proportions accordingly. The mistake won't show up in the slip house, where the clays and the powdered flint are mixed with water into a thick cream that may well be called "slip." But the truth will out when the biscuit is examined after firing.

Some of the baked ware may show defective specks because in the running of the slip over magnets to remove the iron, or in the straining through fine lawn sieves, some impurities still remained. The purifying, filtering and mixing of the clay are mechanical processes in which the American potter has made great improvements.

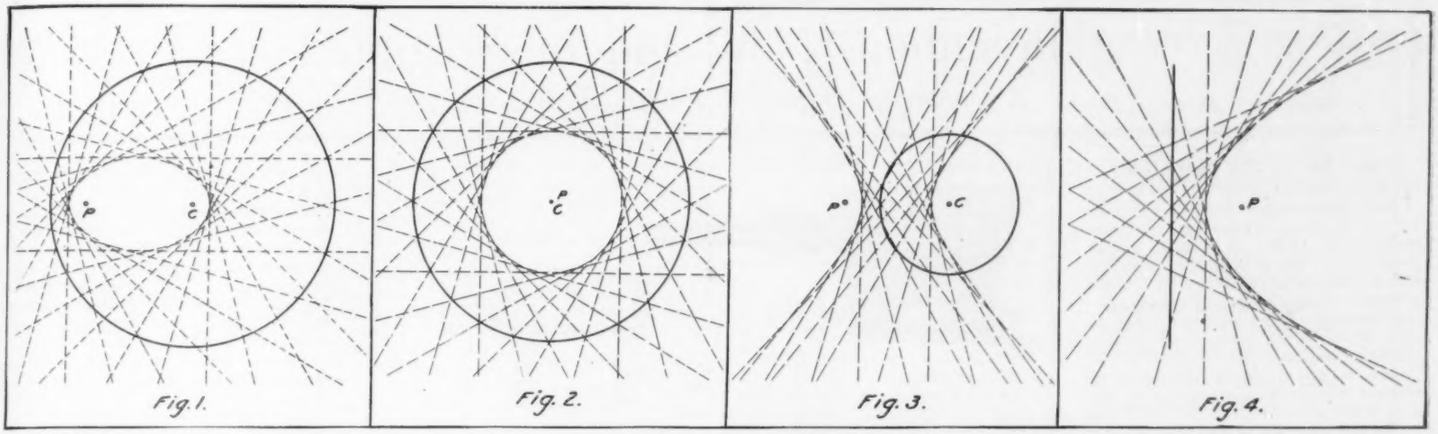
In England it would be counted a sacrilege to wash the windows of the pottery or to whitewash the walls, to keep the white powdery clay within bounds, or to group the processes to avoid waste of time and effort. In the fine china potteries of Britain they knead the clay, not by means of a pugmill, but by hand. A man whacks the clay with a huge mallet, and thereby does something to it that machinery cannot do, just as the woman who kneads her bread and does not trust it to the mixing machine gets bread of a better quality. It was to get this quality in the dishes made for royalty that in the old days men trod barefoot on the clay.

One can hardly imagine our labor doing that—nor can one imagine our potteries turning out anything like the Wedgwood Queensware. Our achievement is in making good ware, cheap enough for every woman to queen with. Democracy even in pottery!

But no amount of mechanical devices can make the American pottery independent of the worker. Besides the fireman, who plays such an important part in the firing of the biscuit and again in the lighter firing of the glaze, there are three important men—the jiggerman, the jollier, and the dipper. It takes three years for an apprentice to acquire the skill for any one of these jobs.

The jiggerman shapes flat pieces, plates and platters. He takes a bat of clay, the thick pancake, that the "batter-out" has formed, and throws it with what is to be the top side down on to a plaster mold. This mold, which is to accompany the plate, absorbing its moisture until it is thoroughly dried, shapes the inside of the plate. The jiggerman revolves the mold and its burden of clay before him, at the same time bringing to bear against the outside of the plate a steel profile that presses the clay against the mold and shapes the back. A little mold-runner at the jiggerman's elbow does nothing but carry the newly shaped plates, each

(*Continued on page 124*)




**In this method of constructing ellipses (Fig. 1), circles, (Fig. 2), hyperbolas (Fig. 3) and parabolas (Fig. 4) by folding paper, the mathematician will recognize an application of the envelope principle**

## Laying Out Curves by Folding Paper

ON a piece of thin paper or tracing cloth draw a circle (Fig. 1) and take any point *P* within the circle. Fold the paper so that the point *P* falls somewhere on the circumference of the circle, and crease it down hard. Open up the paper and in the same manner fold it again and again so that the point *P* falls successively on a number of points completely around the circumference. It will be found that the successive creases in the paper have traced out an ellipse, as shown by the dotted lines in Fig. 1. The transverse axis of this ellipse is equal to the radius of the given circle, and the foci are the point *P* and the center *C* of the circle.

If we prepare several pieces of paper with the point *P* taken successively nearer the center *C* of the circle, the resulting ellipses will be found to have successively less eccentricity and to approach a circle in shape, until finally when the point *P* coincides with the center of the circle, as in Fig. 2, the curve traced by the creases is a circle.

If, now, we consider the point *P* as moving farther from the center of the circle, the resulting ellipses—with transverse axes always equal to the radius of the given circle—become flatter, until, when the point *P* is actually on the circumference of the circle, the ellipse degenerates into a straight line.

As soon as the point *P* crosses the circumference and is outside of the circle, the creases in the paper trace an hyperbola. As in the ellipse, the transverse axis of the hyperbola is equal to the radius of the circle and the foci are the point *P* and the center *C* of the circle (Fig. 3).

When the given circle is considered to increase indefinitely in size until the comparatively small portion of its circumference that can be shown on a sheet of paper is practically a straight line, the curve traced by the creases resulting from folding the point *P* on successive points along this straight line is a parabola. The point *P* is the focus of the parabola, and the straight line its directrix (Fig. 4).

That these curves are true "conic sections" and not haphazard shapes may be proved by anyone familiar with the methods of analytical geometry—the equation of anp one of the creases, referred to rectangular coordinates, may be thrown into a form recognizable as the equation to a tangent to the particular curve under investigation.—By *Francis M. Weston, Jr.*

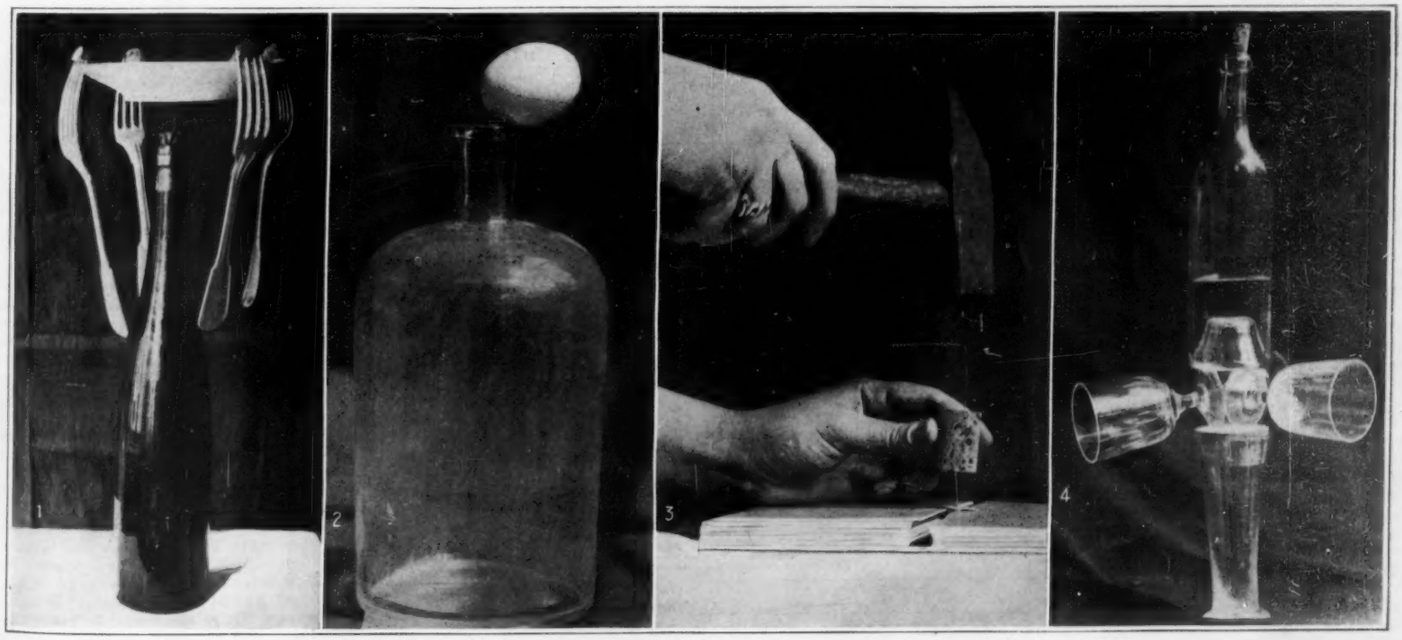
## Tricks With Bottle and Glass

AMONG the old friends that are always new are the bottle and glass tricks which are brought to our attention every little while. One of the most surprising, to those who have never seen it before, is the spinning of a plate on a needle-point. The first property for this stunt is a bottle. A needle is driven firmly into the cork, leaving a goodly section of the steel projecting upward. A second cork is cut into four pieces, as nearly equal in weight as convenient, and into each of the fragments a fork is securely fixed. It is of course necessary that the forks be uniform, and that enough of the cork project at the front of each so that the forks may be suspended about the edge of a dinner-plate as indicated in the picture. When all these preliminaries have been attended to the plate and all its contents may be spun upon the end of the needle without even threatening to fall off. The secret, of course, lies in the low center of gravity of the ensemble.

Balancing an egg in any position on the edge of a bottle-neck is another trick that will startle the uninitiated. This time it is the egg that has to undergo a process of preparation. It must be punctured at both ends and blown, and then filled with fine sand. That is all; it will then stand wherever and however we put it—again because of the fact that in all its positions the center of gravity falls within the base on which it is standing.

Knowledge of how to do it rather than any special preparation is necessary for the third trick illustrated, in which a needle is driven through a coin, contrary to the impression which anyone would register that it cannot be done. The coin must be placed across the opening between two tables or two books, so that its center is clear beneath. Then the needle must be inserted in a cork in such fashion that its point projects on the one side while its head is about flush with the surface of the cork on the other. Under no circumstances must the head be exposed so that the force of the blow can fall directly upon it, however. If the instructions are faithfully observed, a single sharp blow from the hammer will penetrate the coin.

A balancing trick comes next. It is plain enough when once explained. The pedestal consists of an ordinary drinking glass, in the opening of which a big flat cork has been secured. On this are put three wine-glasses, rimwise, as indicated in the picture; and the only trick is the holding of these in place until the bottle can be set over them. Once there, the pinnacle-piece will hold the assembly together very nicely.




**Four surprising tricks that may be performed with bottles, glasses and corks, as explained in the text**

# Inventions New and Interesting

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## First Aid to the Carburetor

THERE are gas-savers and gas-savers, but when one goes out to get a story on one of these devices he is usually disappointed to find it nothing beyond the familiar idea of supplying more hot air to the mixture after it passes through the carburetor. When a gasoline economizer appears that acts in some other way we have a story of more than common interest.

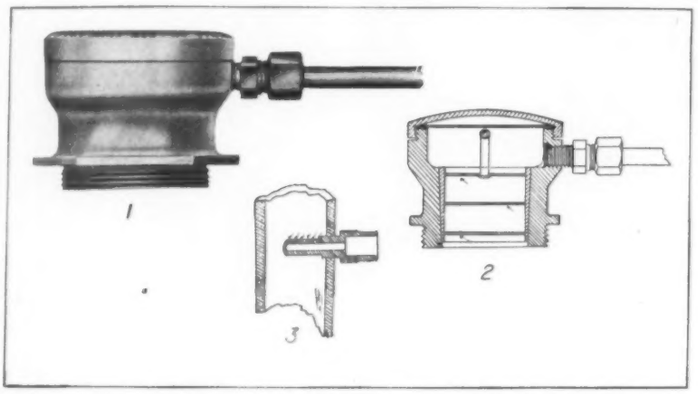
The corburetor is not, inherently, an efficient mechanism, especially with the sort of fuels we feed it today. Its goal is the manufacture of a completely gaseous mixture of air and gasoline, entirely analogous to that of oxygen and nitrogen in the air itself. The ordinary result falls far short of this in that a considerable quantity of the gasoline is not gasified or mixed at all, but is carried into the intake manifold in the form of minute drops of liquid, suspended in the current of gas. Such drops may burn, but they can never explode.

The present inventor may have got his inspiration by applying his nose to the orifice of a gasoline tank, and realizing from the odor that in the atmosphere immediately above the liquid a natural process of carburetion was going on. But here no drops of liquid are sprayed into the air, the explosive mixture being produced solely through the ability of the air to absorb the volatile liquid in gaseous form. In this mixture there will be no droplets—nothing but explosive gas. Why not introduce it into the cylinders?

That is precisely what the apparatus pictured does. A pipe is threaded into a hole bored in the intake manifold, and its other end carried to a member that screws over the filling hole in the fuel tank. As soon as the engine turns over, suction is set up in this auxiliary feed line as well as in the regular one; the vapor from the fuel tank runs into the intake, there joining the mixture from the carburetor.

Among the details worthy of attention may be mentioned the safety arrangement. Every engine backfires now and then. Under standard practice, the worst thing that can follow is the blowing out of the carburetor. But an engine that can backfire directly into the fuel tank would be something more serious. So in this device the auxiliary feed enters the intake manifold through a tiny nozzle, shown at 3 in our diagram, the holes in which are extremely minute. In the second place, if combustion should get through these, it would be

(*Continued on page 124*)




1. External appearance of the member that fits over the filling hole in the fuel tank. 2. Section of this member. 3. Section of the plug that screws into the intake manifold: the arrows indicate the tiny holes out of which the gas issues

**Gas from the fuel-tank to help out the carburetor**

## The Handling of Awkward Materials

HAND transportation is rapidly giving way to power-driven devices. The most difficult material to handle is long stuff. In fact, until the appearance of the new straddle truck, which is shown in the accompanying illustration, the handling of awkward materials has always presented a problem which had to be solved with improvisations.

The new straddle truck imposes no limit to the length or height of load. The top of the platform or bolsters need only be four or five inches above the floor, and no small wheels are required to go underneath the platforms. This is an advantage in hauling heavy articles like machinery. Material to be transported is piled on platforms or in boxes and long stuff may be placed on two simple bolsters. Loading and unloading are thus accomplished while the truck is busy doing useful work.

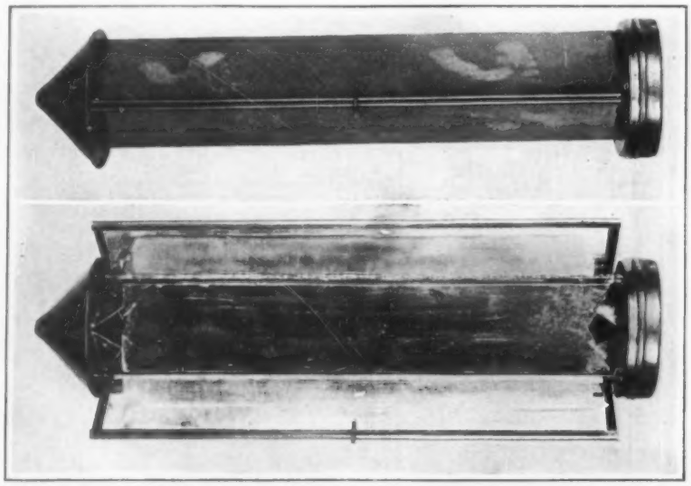
Structural steel may be readily handled with this straddle truck. The lengths that may be handled are practically limited only by the space available for turning. And as the center of turning radius virtually coincides with center of length of load, the action is almost equivalent to a turntable. By means of platform units, package freight, heavy machinery and other articles can be readily handled, as shown.

The straddle carrier is the invention of H. B. Ross of Benton Harbor, Mich. It will be recalled that a larger machine of this kind is being employed in lumber yards. The present machine, like the larger one, is driven by storage battery. The hoisting gear, which is motor-driven, will sustain the load at any point of lift, but at the maximum lift all load strains are relieved from the gearing. The operator cannot raise the load above a fixed point.

**Two views of the straddle carrier, showing its use in handling structural iron and in handling heavy machinery by means of platform units**

## A Collapsible Kaleidoscope for the Inquisitive

A MANUFACTURER of physical apparatus in Cambridge, Mass., has introduced an interesting kaleidoscope, which will give the young student an idea of how this instrument works.



**The collapsible kaleidoscope, shown closed for operation and open so as to reveal its parts to the inquisitive user**

This kaleidoscope, shown open and closed, is made wholly of metal, with the exception of the reflecting mirrors. The tube consists of three strips of metal two of which are hinged to the third as shown in the lower figure. Upon these are mounted strips of glass mirror plate, which give the beautiful figures formed by the objects in the cell or box at the bottom. A hook on one of the sides holds them together when closed as shown in the right-hand view. The conical part at the top has an opening about a quarter of an inch in diameter for viewing purposes. This as well as the box at the bottom is fastened firmly to the strip to which the doors are hinged. This box has a clear glass side on the inside and a ground glass side on the outside. In this box are placed the bits of colored glass, or other more elaborate objects found in some kaleidoscopes, which form the beautiful figures seen on looking through the tube toward the light. The figures formed in this instrument are six-sided, because the angle between the mirrors is 60 degrees and this is contained in 360 degrees of a circumference 6 times. By rolling the kaleidoscope as one looks through the tube an endless variety of figures is formed, all of them beautiful and no two alike.

## Railroading Under Roof

(*Continued from page 112*)

ing received the staff entitling him to possession of the block releases the brakes and proceeds. A skilful and almost continuous use of the brakes is required to keep within the passenger train speed limit of 28 miles an hour. Several times during the coast down the mountain the train stops for about five minutes to allow the wheels to cool.

For freight trains still greater precautions are necessary. The head engineer on west-bound freights applies the brakes and stops a little more than a train length after leaving Tunnel No. 6 which is on the east side of the Summit. If he did not stop he would run through a siding, out of the sheds and on to the ground; for the switch is always set for the siding and must be thrown by the head brakeman. After the helper is cut off the engineer charges the train, following which all retaining valves are turned up. Then the air is tried by opening the angle cock at the rear of the caboose which sets all the brakes.

If all is well the brakes release and the engineer, having received the staff, proceeds without waiting for a signal from the rear of the train for the excellent reason that no signal could be given. All communication between front and rear of the train is entirely cut off while the train is in the shed and all usual methods of operation are abandoned. The flagman hangs a Dietz lantern under the rear platform close to the track and stations himself on the platform where he keeps a close watch of the track. If he sees ties freshly splintered he knows a car is off, so he opens the emergency valve and stops the train.

So long as the lights at the entrance to each block are both green the engineer keeps going, exchanging staffs by means of a staff catcher at the side of the cab. But if the home signal is red and the distant signal is yellow he retains his staff and enters the siding. There being no way to get a signal from the rear of the train the engineer watches the signs on the side of the shed which are numbered "20," "25," "30," and so on until he is opposite the number corresponding to the number of cars in his train, when he knows he is in to clear, so he stops and stays until the opposing trains pass.

Six times during the descent of the mountain the train halts while the train is inspected as the wheels are cooling. A man on each side passes along the length of the train looking for brake beams down, cracked or broken wheels and noting the temperature of the wheels. If a car has wheels too warm the retainer is turned down to give the wheels a rest except when the engineer holds the brakes on. If a car has hot wheels the brake-piston travel and the brake rigging are investigated to see if the brake shoes are being held against the wheels. Often the wheels are hot enough to burn the fingers; sometimes they are red hot; sometimes they get hot enough to burst. But sometimes they are so cool they show that the cars are not doing their share of holding the train.

Two Wompuses are assigned to a fruit "block" of 45 cars east bound, the helper being placed ten cars from the rear end. In the sheds not even the usual whistle signals between lead engine and helper can be exchanged, for whistle signals cannot be heard. So when a train pulls in on a siding the head engineer releases his brakes and lets the slack run back on the helper who sets his independent driver brakes as soon as he comes to a stop. When the lead engineer is ready to go he sets the brakes with a heavy reduction, then releases. The engineer on the helper takes the release as a signal to go, releases his independent driver brakes and begins to work steam.

The engineer cannot even get a signal from the fireman in taking water in the sheds. Instead he stops at a mark opposite his window. All flagging is done by torpedoes. Section men and bridge carpenters, who are constantly at work in the sheds put out torpedoes on each side. The roar in the sheds is so great that even torpedoes cannot always be heard, but a well-trained nose can smell them. The engineer also depends on his sense of smell to warn him that drivers are slipping, otherwise he might never know it. In the same way the engineer detects hot boxes.

His sense of touch guides the engineer in the use of throttle and brake valve. He has no means of knowing whether the injector is working except by feeling the supply pipe; for if he put his head out of the window to look at the waste pipe he would get it knocked off.

A break-in-two in the sheds means a delay of an hour to two hours. A man has to walk over the train for he cannot walk beside it in winter, to find out what is wrong. Then he has to walk to the caboose, hoist a chain to the top of the cars, drag it along to the break, walk over the top to the engine, tell the engineer exactly how far to back up, chain the break together, then walk to the engine once more to tell the engineer to go ahead, for there is no possibility of passing signals.

## Saving St. Paul's in London

(*Continued from page 113*)

repairs of the southwest and southeast piers took place owing to crushing of the stone casing.

The building itself gives us the best indications of what happens. We find that the impost molding in the crypt has a 3-inch band of stone underneath it, which is a pretty sure indication that the pier sank that much before the impost was placed in its present position.

We are face to face with certain facts. First, the masonry of the piers has been crushed. Second, the agglomerate of the piers is not as good as it should be. Third, to whatever cause it may be due, the piers have settled. Therefore, our best course is to make the piers as sound as we can, and, like Wren, trust the foundations to keep up the present fabric as it did its predecessor. This, then, is our present endeavor. We cut out stone by stone the crushed masonry, and reinsert sound, using every care not to remove too much at a time. That so far we have been successful is a tribute to the vigilance of the workmen and the efficient supervision of the contractors. The first pier (southwest) has been practically renewed without an appreciable crack being visible. We are now treating the southeast pier in the same way. After we have inserted the new stone we endeavor to consolidate the rubble as far as possible by pouring in liquid grout by gravitation. As a safeguard against any unforeseen settlement, we are erecting a steel center under the South Transept Arch to pick up the weight should any failure of this work take place.

## Getting the Rest of the Oil

(*Continued from page 114*)

rock in its structure. Therefore, it is practicable to duplicate in miniature the several strata that influence directly the underground migrations of oil, water, and gas when man disturbs nature's subterranean equilibrium.

The heavy face plate of the tank permits the experimenter to watch the changes promoted by the application of the forces and by the introduction of fluids at his disposal. Again, when the test covers an interval of some hours, for example, photographic records can be made at prescribed intervals. In this way are obtained data which can be examined at leisure. Facts of importance are thus brought to light which might escape observation during the shifting of the masses. It should be mentioned here that the Mills apparatus is large enough to allow the investigations to be conducted on a scale of sufficient magnitude to avoid any misleading effects of capillarity. By using sands that are more or less saturated with oil and water, the capillary forces at work are far weaker than the other ones that are deliberately called into action by the investigator; and the latter are subject of his immediate inquiry. It should be understood, of course, that the experimental tanks can be carried to laboratories situated in the oil fields, and there employed agreeably to the geological conditions disclosed by the driller's log and other information obtained during the operation of a well or group of wells.

It has for many years been suspected that the migration of oil under ground, once man destroyed the balance of the pent-up energy, might cause the petroleum to be trapped so that it could not be drawn surfaceward by the pumps of existing wells; and, similarly, it was believed that a lack of understanding on the part of the operator led all too often to movements below ground that would shorten to a greater or lesser extent the profitable productive life of a well or wells. Mr. Mills has confirmed these assumptions and his tanks give visible evidence of much suggestive value.

He has made it clear that, with suitable information available, it is possible to adopt preventive measures that may be counted upon to check or correct subterranean water troubles that have interfered or threatened to interfere with a well's yield of oil, and thus to prolong to a marked degree the life of that well and, perhaps, of a wide neighboring area. Again, in a kindred way, his tests disclose how the "nursing" of the natural gas associated with a given pool arresting its untimely escape, may serve to drive the oil to the shot holes or pump intakes, and eventually bring about the extraction of a far larger percentage of the petroleum than might otherwise be feasible. And then, the apparatus has revealed how compressed air, forced down from the surface, may be relied upon to take the place of the vanished natural gas in promoting the recovery of oil. Finally, if time be allowed for the disturbed or remaining fluids to readjust themselves, it seems that the oil may assume another position which may aid its extraction. In other words, intermittent pumping of a well may give better results than continuous operation; and even apparently exhausted wells, in some circumstances, may be found productive after a period of inaction.

## Enemies of Timber Construction

(*Continued from page 118*)

Atlantic and Pacific coasts of America and the coasts of Europe. The *chelura* is another diminutive enemy of submerged construction in salt water. It occurs in great swarms and the mode of attack is similar to that of the limnoria. Common names are sea fleas and red-wood lice. The *spharoma* is yet another shell animal. It resembles the limnoria, but has a rounded instead of a flattened body. It is a little bigger, excavating a burrow with a diameter of 1/8 to 3/16 inch and a depth of 1/8 to 1/4 inch. It is less common that the limnoria, but infests fresh as well as salt water. The *martesia* is still another enemy of marine construction. When the martesia enters a timber, the perforation will be only about 1/8 inch in diameter; but the burrow inside may reach a diameter of 1 inch. It is thought that the burrow is not excavated for food but for use as a retreat. The head is bivalvular. It is pretty much the whole affair. When operating upon a timber, the head opens and a hard and rough tongue begins action. As it works back and forth, the hole is cut. The martesia does not seem particular as to the material into which it bores. Tar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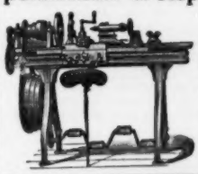

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paper, asphalt coating and the contained pile—all seem to yield to its efforts. It is even claimed that it will cut into rock. A metal sheath appears, however, to be proof against it. Apparently, this animal has not given a great deal of trouble to engineers as yet. However, it has appeared near the Pearl Harbor dry dock in the Hawaiian Islands and elsewhere in that general neighborhood.

Engineers, contractors and others concerned, are desirous of safeguarding submerged wooden structures. Wood, when continually submerged, is a fine material for foundation purposes. Concrete may generally be substituted; but the expense is often very considerable, partly because of transportation and partly because of other considerations. Suitable timbers are often available nearby and at advantageous costs. The world over, timber substructures are probably very much oftener to be found in salt-water construction. The most serious objection—apart from the susceptibility to the attacks of marine borers—is that wood above the water line is rather subject to deterioration. This is something, however, which may be pretty well pre-determined. The operations of the teredo and its allies are scarcely subject to exact determination in advance. All kinds of prevention methods have been tried. The wood has been impregnated with this or that chemical: the timber has been painted with various substances; the pile has been wrapped or sheathed with numerous varieties of coverings.

Creosoted piles have had a life of 18 to 20 years. These were sticks taken from Long Wharf. They were, in fact, not removed because no longer useful, but because the structure was being dismantled. San Francisco Bay is a body of water swarming with various boring molluscs. There is a long trestle reaching out beyond 2 miles from shore but not into deep water. At the point 2 miles out the water is only 5 feet deep, and at the terminal from 12 to 30. These depths are at low water. Untreated piles put down in 1902 had, many of them, already broken off and been carried away by 1906. But the trestle still stood. In 1906 and 1908 piles of Douglas fir were protected by paraffin paint from the mud to high water lines. In 1912 a detailed examination was made, which showed that the teredo had not been especially active in the inner 2-mile section. But the limnoria had been quite successful in coning piles off from the high water level down to the mud line. When a pile had only about 2 inches of sound wood left, it would break off. Nevertheless, some piles were found to have had a life of 8 to 12 years. The teredo and the limnoria did well for themselves in the section beyond the 2-mile point. The piling would break off just above the mud. There was uniform coning from high water down to the mud. The section in this region would be 6 or 8 inches through and completely honeycombed by teredo burrows. Under the terminal structure, piles had a susceptible region 18 feet long between high water and mud, but other timbers were so located that the mud was 32 feet below high water. Nevertheless, the limnoria and the teredo got in their work.

Perhaps less attention has been given to the destructive activities of land forms of life. The *white ant* may be regarded as the leader of these, insofar as timber construction is concerned. It attacks the wood of the foundation timbers and of the planks in basement floors. This pest operates not only upon structures in the country but also upon those in large cities. While the South Atlantic and Gulf states constitute the region most infested, the northern states are also liable to invasion. The white ant is known to have been active as far north as Manchester, N. H., and Benton Harbor, Mich. It attacks wood that is partly in contact with the ground or which is so situated as to be accessible from it. Concrete may not prove effective as a protective sheath, since weathering or settlement productive of cracks may open the way to the wood. The favorite regions for white-ant activities are those that are dark, warm and moist. They work readily in damp or decayed wood. But where penetration is impossible, the white ant may still pass the barrier by means of little shelter sheds or earthline tubes. It constructs these of earth and excrement and runs them, if need be, up from the ground.

The timbers of bridges and wharves, telephone and telegraph poles, mine props, railroad cross-ties, cypress water tanks, etc., are subject to attack, under favorable circumstances. The ants are able to penetrate dry, hard wood, even though it is elevated above the ground, provided the intervening obstacles are not too great. Moisture somewhere is needed—preferably in the form of moist earth—but not necessarily at the point of activity. By mixing moist earth and the wood which has passed through the body, the white ant is able upon occasion to create more favorable conditions as to moisture.


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## An Ancient Art in Modern Dress

(*Continued from page 120*)

on its mold, to the moving shelves that convey them through a heated air shaft until dry. The jollier is like the jigger-man, except that he works with cups and bowls, where the steel profile shapes the inside instead of the outside of the pieces.

Some irregular pieces, such as pitchers, have to be pressed by hand against a plaster mold, each half of the pitcher being formed separately between two plaster molds and partly dried before it is dipped in thick slip which acts as mucilage to join the handle to the rest of the jug.

One is tempted to linger, watching the creation of forms from shapeless clay. But there is still the drying, sponging, smoothing, and firing of the biscuit before we come to the wonderman, the dipper. Seeing the ware handled so many times and undergoing trial by fire, one marvels that there is anything left by the time it gets to him, or as a result of his work. For there is always the risk that the dipper will put on too much or too little glaze. As he takes in his wet fingers a piece of baked earthenware, each piece differing in its degree of porosity, he has to determine instantly by the feeling of the water being sucked into the pores of the biscuit, how long to let the piece remain in the tub of liquid glaze, a matter only of seconds anyhow, and how much glaze to shake off. If too little adheres, the dishes will be rough when the glaze is fired, and, if too much, the glaze when fired will be discolored. What is worse, it will crackle in heat or cold, letting stains and grease come in contact with the porous body below.

The glaze is what gives to earthenware its shiny, dense surface. This surface is an aid to long life and a protection against germs, stains and grease marks. Moreover, when earthenware is decorated under the transparent glaze, the glaze protects and preserves the design. The three lumps on the back of a plate or cup show where it was supported so it would not adhere to another in the melting of the glaze. These rough places have been almost smoothed off by girls with dressing irons who have the knack of hitting the lump and not the dish.

## First Aid to the Carburetor

(*Continued from page 122*)

stopped by the three diaphragms of the filling-hole cap, with their staggered pinholes as shown by the arrows at 2. As a result of all this, the apparatus carries the indorsement of the fire underwriters.

When we bring fuel to the engine in this novel fashion, we do not get enough fuel, or sufficiently rich fuel, to drive an automobile. What we do do is to enrich with this direct feed the fuel fed through the carburetor in the ordinary fashion. The carburetor is now called upon to supply only a part of the explosive charge, the more efficient part being supplied by the new means; so, in the end, less gasoline is burned to secure a given result than if the entire charge were supplied by the inefficient carburetor. The setting of the carburetor is much leaner with the attachment than without, and this affords the visible means of the economy.

The Editor was not willing to admit this argument as more than a mere argument until he had seen it demonstrated. So a Ford car on which the attachment had been installed for some time was driven over a course of about twenty miles, first with the device and then without it. In the test with the device the carburetor was not tampered with, but was left as the owner had been running it. In the other test, it was necessary to adjust it to a richer mixture in order to run the car at all. The Editor took charge of this business, and throughout the run manipulated the dash control in such style that the mixture was maintained as lean as it could be without causing the engine to buck.

Before the test the gasoline stood exactly six inches high in the rectangular tank; after the first leg at 5.55 inches; after the second at 4.87 inches. It will be seen that this gives a fifty per cent improvement running with the "gasifier."

In the way of general remarks, it may be pointed out that the apparatus can be detached, for a test or for other reasons, with singular ease. The plug that carries the line into the intake manifold has only to be removed, and a solid plug screwed in in its place. Such a solid plug is part of the apparatus as supplied. The device is operative on any car that has gravity or vacuum feed, the pressure feed alone being barrier. It is sold under a guarantee of fifty per cent improvement, and we are told often scores much more than this.

During the test that was conducted for our benefit, the carburetor adjustment was so lean when the device was in operation that with the engine idling, a half-turn of the adjusting rod was sufficient to stall it. The difference in adjustment between the two runs was about 1½ turns. As evidence of the powerful suction in the auxiliary fuel line, the screw top was removed from the member that covers the filling hole in the tank; there was an audible rush of air through the line that stalled the engine instantaneously. From the distance covered and the height of the gasoline the performance was worked out in terms of gasoline-miles, and found to be 20¾ without the new device and 31½ with it. This shows that the car was in good order, without having been tuned up for the test. It was of course examined for hidden fuel chambers and other artifices, and found to be a perfectly regular coupe, plus the gas-saving installation. Unlike many of the fuel savers, this one is not restricted in its application to the Tin Lizzie, but is made for all cars and is equally effective on them all—barring, of course, the pressure feed. The manufacturer claims that the high-grade gas from the fuel tank not alone saves gasoline, but increases power. The car used in the test ran very satisfactorily throughout, and barring a possible slight difference in acceleration, we were unable to verify this; but it is of course entirely reasonable.

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Will Japan establish a naval base in the South Seas among the Caroline, Marshall and Mariana Islands?

What of the 50,000 natives on those islands? What of our trade opportunities in those coral ports, while Nippon's flag flies above the little palm-shaded custom houses?

Get ready for November eleventh — and the Great Conference. Read this timely and important article, "Japan's Mandate in the Pacific," by Junius B. Wood, who recently spent several months in the South Seas investigating conditions in the Islands now under Japanese administration, in the September

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By MOISSAYE J. OLGIN

A burning article by a man who is a friend of the Russian peasant. Vividly and very personally, we see the workings of a village Soviet from the "inside"—the land is apportioned, the community smithy works for all, the peasant's voice is heard, in the village theatre the boys and girls enact plays written by themselves. Out of all the dark misery and poverty the bright lamp of hope burns bravely.

**Can We Keep Up With the British?**
By J. B. POWELL

Our share of the world's trade is one of the things that helps make this country "go 'round," but can American business ever function efficiently in the Orient unless Washington comes to its rescue? An American judge in Shanghai is trying to apply outworn statutes of Alaska to great American interests in China, because, there are no better. Can America ever be a great foreign trader under such conditions?

**Sky Pilots in the Paumotus**
By FREDERICK O'BRIEN

Another glorious article on the South Seas. The natives in Anaa have neglected church since Lacour, the trader, got his cinematograph. They are crazy over motion pictures of "cowaboyas." Lacour's entrance fee is twenty-five cocoanuts. An ordinary audience leaves 4,000 nuts in Lacour's copra shed. Good business, that!

**Heera Singh and His Neighbors**
By NARAIN ASHUTOR

A picture of village life in India, written by a young native, a graduate of Oxford, whose sophisticated reactions to the customs of his native land make brilliant reading.

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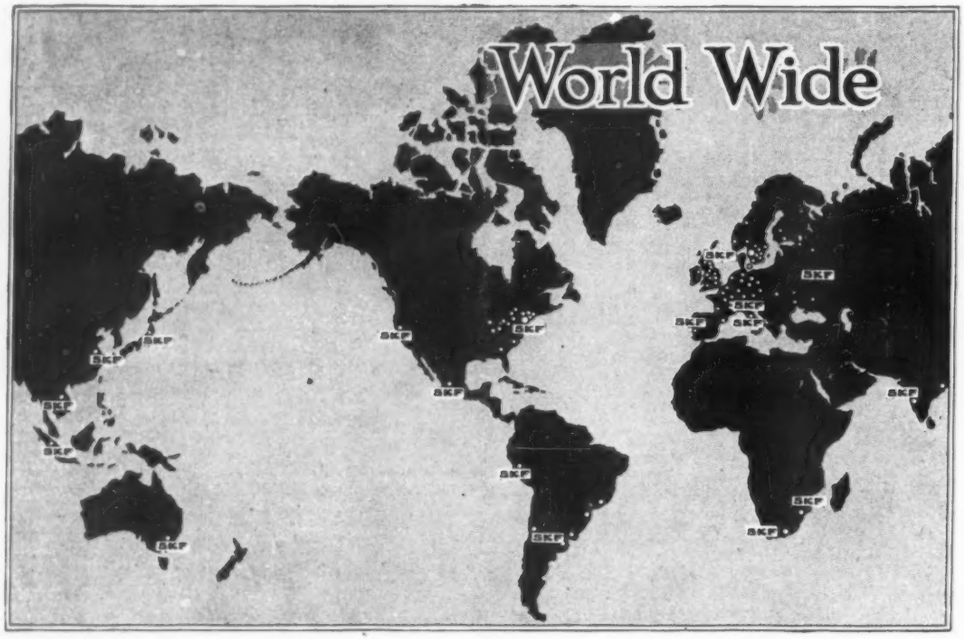


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